USER
MANUAL

Pinnacle™ 10x6 kW (300–700 Vdc) and (400–1000 Vdc)

DeviceNet™, MDXL User, UHF Output

5702184-C
April 2002

ΔE ®

User Manual

Pinnacle™ 10x6 kW

5702184-C

ΔΕ ADVANCED ENERGY®

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Introduction

READ THIS SECTION

We know that some of you want to operate your Pinnacle supply now and that you don't feel you have time to read the entire manual. Below is a list of manual subsections you must read before getting started.

- "Theory of Operation" on page 2-2
- "Electrical Specifications" on page 3-4
- "Operating Overview" on page 6-1
- "Installation" on page 5-1
- "Conditions of Use" on page 1-6

INTERPRETING THE MANUAL

The following sections explain the type conventions, icons, and symbols that appear in this manual.

Type Conventions

Please note the following type conventions:

- Pin and signal names appear in capitalized italics (*DUTY_CYCLE*).
- New terms appear in italicized text.
- Unit labels (switches, indicators, and other controls) appear in capital letters (MODIFY). Exceptions are port names, which simply begin with a capital letter (User port).
- Commands (**162**) and command names (**setpoint**) appear in boldface lowercase letters.

Icons (Symbols)

This symbol represents important notes concerning potential harm to people, this unit, or associated equipment. Advanced Energy® includes this symbol in Danger, Warning, and Caution boxes to identify specific levels of hazard seriousness.

1027

⚠️ **DANGER:**
> **This box identifies hazards that could result in severe personal injury or death.**

⚠️ **WARNING:**
> **This box identifies hazards or unsafe practices that could result in personal injury.**

⚠️ **CAUTION:**
> **This box identifies hazards or unsafe practices that could result in product or property damage.**

The following labels may appear on your unit:

- Hazardous Voltage

⚠️ **WARNING**
HAZARDOUS VOLTAGE
Risk of death or bodily injury.
Disconnect all sources of input
power before working on this
unit or anything connected to it.
6306041A

1332

- Short circuit protected

1024

- High voltage

1028

- Protective earth ground

1029

- Earth ground

1069

- Warning (refer to manual)

1027

- CE label

1020

- Non-ionizing radiation

1030

- Hot surface

1309

- NRTL /C label

SAFETY

Do not attempt to install or operate this equipment without proper training.

- Ensure that this unit is properly grounded.
- Ensure that all cables are properly connected.
- Verify that input line voltage and current capacity are within specifications before turning on the power supply.

- Use proper electrostatic discharge (ESD) precautions.

- BE CAREFUL AROUND THIS EQUIPMENT.

⚠ **DANGER:**

RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.

PRODUCT COMPLIANCE AND CONDITIONS OF USE

The following sections include information about unit compliance and certification, including the conditions of use and installation required to be in compliance with the standards and directives.

Safety and Compliance Directives and Standards

Certain options of this unit have been tested for and comply with the following safety and electromagnetic compatibility (EMC) directives and standards and semiconductor industry guidelines:

Table 1-1. Electromagnetic Compatibility (EMC) Directives

Directive	Description
89/336/EEC	EC Council directive on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive)

Table 1-2. Electromagnetic Compatibility (EMC) Standards

Standards	Description
47 CFR Part 18	Code of Federal Regulations—Limits and methods of measurement of radio interference characteristics of industrial, scientific, and medical equipment
EN 61000-6-2	Electromagnetic Compatibility (generic immunity standard—industrial)
EN 55011	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific, medical (ISM) radio frequency equipment (Class A, Group 2)(CISPR 11)

Table 1-3. *Safety Directives*

Directive	Description
73/23/EEC	EC Council directive on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LVD—Low Voltage Directive)

Table 1-4. *Safety Standards*

Standards	Description
UL 1950/CSA C22.2 No. 950	Safety of information technology equipment including electrical business equipment
EN 50178	Electronic equipment for use in power installations

Table 1-5. *Semiconductor Industry Guidelines*

Standards	Description
SEMI S2-0200	Safety Guidelines for Semiconductor Manufacturing Equipment

This device must be installed and used only in compliance with the standards listed in addition to VDE 0113, EN 60204 (IEC 60204), and applicable requirements.

Certification

Certain options of this product are certified by:

- Canadian Standards Association (CSA) (NRTL/C)
- CE marking, self addressed by AE Compliance Engineering
- EMC measurements, verified by TÜV Product Services

For more information, refer to the letter of conformance (US) or declaration of conformity (EU) accompanying the product.

Installation Requirements

Install this unit according to the following requirements.

> ⚠ **WARNING:**
> **Operating and maintenance personnel must receive proper training before installing, troubleshooting, or maintaining high-energy electrical equipment. Potentially lethal voltages could cause death, serious personal injury, or damage to the equipment. Ensure that all appropriate safety precautions are taken.**

> ⚠ **WARNING:**
> **RISK OF DEATH OR BODILY INJURY. Disconnect and lockout/tagout all sources of input power before working on this unit or anything connected to it.**

Conditions of Use

To comply with the stated directives and standards, you must meet the following conditions of use:

- This device must be used in an overvoltage category II installation only.

- Before making any other connection, connect the auxiliary protective earth ground conductor on the rear panel.

- Use only a shielded cable on the input power connector.

- Use only a shielded power cable on the output power connector.

- Install and operate this device only in a pollution degree 1 environment, which means an indoor location such as a computer room, office, or factory floor where either no pollution or only dry, non-conductive pollution occurs. (The pollution has no effect on operation.)

- Non-standard connectors for input and/or output power must be inaccessible to the user.

- If your unit does not have a circuit breaker, install and operate it with an AE-approved circuit breaker on the AC input to provide the required over-current protection.

Theory of Operation

GENERAL DESCRIPTION

The Advanced Energy Pinnacle™ series of DC power supplies provide the ultimate advantages in DC power.

They...

- Are light and compact

- Are highly efficient (low internal heat dissipation)

- Provide excellent regulation and stability

- Have a highly reliable solid state design

- Store very little energy in the output filter

- Quickly extinguish and recover from arcs

- Deliver full power over a 4:1 impedance range (with no taps)

Output Impedance Range

No taps, mechanical or electrical, exist in the Pinnacle supply. The unit delivers full power over a 4:1 impedance range without the need for tap changes. You never need to open the unit or generate signals to control taps.

Output Regulation

The Pinnacle supply can be used as a power, current, or voltage source, depending on the method of output regulation selected. Since setpoint levels are stored in nonvolatile memory, you can use them to recover from input power interruptions and to ensure repeatability from run to run.

Interfaces

Pinnacle power supplies can be configured with a variety of interfaces. Your Pinnacle supply can be controlled from an active front panel, a Pinnacle Remote Active Panel, an analog/digital connector (User port), or a serial communications (Host) port. The serial communications port, active front panel, and Pinnacle Remote Panel provide access to all operating parameters and control functions. The User port provides limited access to operating parameters and control functions.

Microprocessor Advantages

The internal microprocessor checks for proper circuit operation while supervising all operating parameters. System diagnostics run when the unit is initially powered up. The most recent power settings and conditions (such as output production) are retained in non-volatile memory.

Displays

The displays on the passive panels as well as the control panels show power, current, or voltage levels. (The displays show levels for unit A and unit B if this is a dual unit.) They also display information about output, setpoint, interlock, bus fault, overtemperature, arcs, and error codes.

Arc-Suppression Feature

The Pinnacle supply's arc-handling feature ensures the shortest arc recovery time in the industry. With the arc-suppression feature enabled, the Pinnacle supply's hard-arc detection time is less than 1 µs, and delivered arc energy is less than 10 mJ for a 10 kW inverter. (Depending on your unit's output configuration, the energy could be significantly less than 10 mJ.)

Additionally, the arc-suppression feature enables you to implement preprogrammed arc-handling functions during your normal process cycle and your target conditioning cycle (TCC). In this mode the arc detect time and arc shutdown time are fixed by target type (metal or nonmetal). But you may also customize your arc shutdown and arc detect delay times by selecting the custom mode. Other parameters, including long arc count limit and voltage trip level, are selectable through the Pinnacle Remote Active Panel or a serial communications (Host) port.

Theory of Operation

The Pinnacle power supply is a sophisticated and intelligent DC power supply designed exclusively for use in vacuum environments. Figure 2-1 on page 2-3 and the following paragraphs outline the theory of operation.
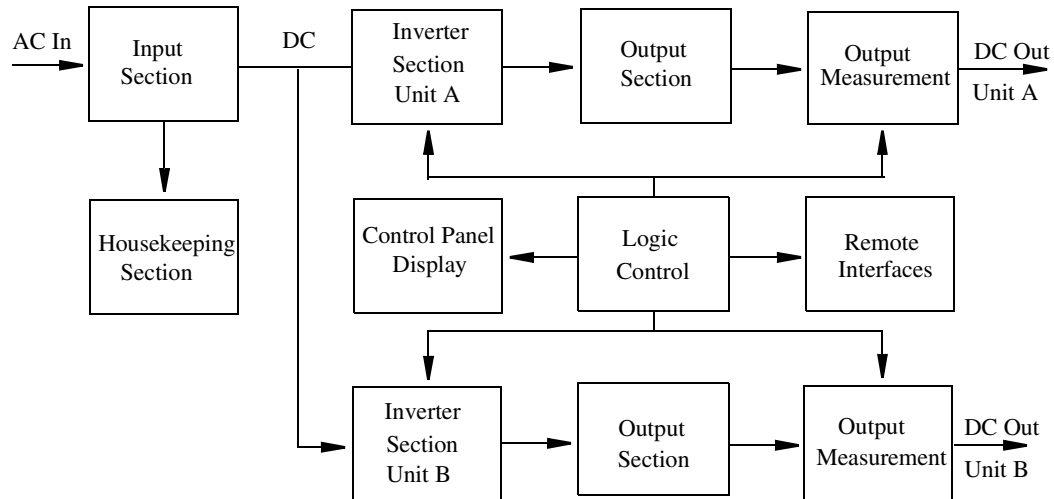
Figure 2-1. *Pinnacle functional block diagram*

INPUT

In the input section, AC line voltage is applied through the circuit breaker to a three-phase contactor. The contactor, when closed, delivers the line voltage to a rectifier bridge, where it is converted to DC. The DC voltage is applied to bus capacitors through soft-start circuitry. This bus provides DC voltage to the inverter section. The input section also provides power to the housekeeping section.

HOUSEKEEPING SUPPLY

The housekeeping supply section provides low voltage to power the electronic circuits within the Pinnacle unit.

INVERTER

The inverter section converts DC to high-frequency voltage by alternating the current through switching transistors.

OUTPUT

In the output section, an isolation transformer steps up the high-frequency voltage from the inverter section and sends it to a full-wave rectifier bridge.

The rectified DC power is then passed through a measurement section to the output connector.

OUTPUT MEASUREMENT

The output measurement section measures current, voltage, and power. These signals are typically scaled 0 to 10 VDC and sent to logic control and interfaces.

LOGIC CONTROL

The microprocessor in the logic control section uses operator-supplied parameters and setpoints to control the output. This section is also responsible for controlling the input section and providing status information to the operator through all interfaces.

REMOTE INTERFACES

The Pinnacle supply supports four types of interfaces: a User port (analog/digital), a serial (Host) port (RS-232/422/485), an active front panel, and a Pinnacle Remote Panel. All four interfaces communicate operator-supplied inputs to the logic control section and provide the operator with status information.

Specifications

FUNCTIONAL SPECIFICATIONS

Table 3-1. *Functional Specifications*

Modes of Control	Serial communications (Host) port, User port (analog/digital interface), active front panel, and/or Pinnacle Remote Active Panel
Passive Panel Options	Your unit also may feature either a passive front panel or a remote passive panel.
Method of Output Regulation	The regulation mode is the parameter that remains constant when the Pinnacle is producing output; it can be power, current, or voltage. Select one of these regulation modes from the optional Pinnacle Remote Active Panel, the active front panel, the User port, or the serial (Host) port.
Programmable Setpoints	You can program an output level (from low values up to the unit's maximum rates of output) for power, current, or voltage. Select this value from the optional Pinnacle Remote Active Panel, the active front panel, the User port, or the serial (Host) port.
Output Limits	You may set maximum output limits for power, voltage, and current. You also may select a maximum strike-voltage range. Select these values from the optional Pinnacle Remote Active Panel, the active front panel, the User port, or the serial (Host) port.
Target Supervision	You can select one of eight target-life counters from the active front panel, Pinnacle Remote Active Panel, User port, or serial (Host) port. Target life can be monitored from the Pinnacle Remote Active Panel, the active front panel, and the serial port. *Note:* The User port has priority when selecting targets.

Table 3-1. *Functional Specifications (Continued)*

Arc Control	Use an active front panel, Pinnacle Remote Active Panel, or a serial (Host) port to enable arc handling functions; then choose between preprogrammed arc controls or custom arc controls. By selecting a target type (metal or nonmetal), you preprogram your Pinnacle unit to use target-specific arc shutdown times and arc detect delay times during your normal process cycle and your target conditioning cycle (TCC). By selecting the "custom" arc handling option, you can program the arc shutdown time and arc detect delay time for your process. Please refer to the "I/O Communication and Control" chapter for defaults and additional information.
Arc Density Monitoring	Using an active front panel, a Pinnacle Active Front Panel, or a serial (Host) port, you can monitor arc density (the number of hard arcs and micro arcs during the previous run). In addition, you can set a window of time for arc density monitoring so that the unit counts the number of arcs that occur during this window.
Arc Energy	< 10 mJ standard
Cooling	Air-cooled only
Ramping Recipes	Not available with this configuration.
Fault Conditions	Several fault conditions will either cause the Pinnacle supply to shut off output or prevent output from being turned on. These conditions include open interlock loops, input power failure, and over-temperature.

PHYSICAL SPECIFICATIONS

Table 3-2. *Physical Specifications*

Size		
	Power Supply	• 133 mm (H) x 483 mm (W) x 639 mm (D), including connectors • 5.22" (H) x 19" (W) x 25.18" (D)
	Pinnacle Remote Active Panel	89 mm (H) x 483 mm (W) x 107 mm (D) 3.5" (H) x 19" (W) x 4.2" (D)
Weight		
Power Supply		30 kg (66 lb)
	Pinnacle Remote Active Panel	6.3 kg (13.9 lb)
Output Connector		Standard is a three terminal, multi-contact, pluggable connector. An alternate configuration is two female UHF connectors, Amphenol Type 83-822/50-239 or equivalent, strain relief box provided. For more information on the output connection, see "Connecting Output Power" on page 5-10
Input Power Connector		Five terminal, DIN compression terminal block
User Port Connector		Please reference the "I/O Communication and Control" chapter.
Serial (Host) Port Connector		Please reference the "I/O Communication and Control" chapter.
Remote Active Panel Connector		9-pin male, subminiature-D
Contactor Interlock Connector		9-pin male, subminiature-D
DeviceNet™ Connector		(If DeviceNet was ordered with your unit) Round 5-pin male connector; please reference the "I/O Communication and Control" chapter

ELECTRICAL SPECIFICATIONS

Table 3-3. Electrical Specifications

208 VAC Pinnacle Input Voltage	Not available for this configuration
208 VAC Pinnacle Input Current	Not available for this configuration
400 VAC Pinnacle Input Voltage	Not available for this configuration
400 VAC Pinnacle Input Current	Not available for this configuration
480 VAC Pinnacle Input Voltage	432 to 528 VAC, 3-phase, 4-wire, 50 to 60 Hz, no neutral required; leakage current less than 3.5 mA
480 VAC Pinnacle Input Current	31 A nominal per phase, at least 90% EFF; 50 A circuit breaker
Output Accuracy	Accuracy of actual output to readback value at 25ºC is ±1% of the setpoint value (V, kW, or A) or ± 0.2% of the full rated output (whichever is greater) for the full input voltage range and output impedance range.
Line Regulation	No accuracy derating for line voltages within the specified input voltage range
Load Regulation	No accuracy derating for impedances within the specified output impedance range
Repeatability	Output power repeatability from run to run at a constant setpoint is 0.1% from 10% to 100% of rated power.
Temperature Coefficient	<0.005%/°C (<50ppm/°C) variation in the regulated output parameter over a 20°C to 40°C ambient temperature range
Output Ripple Voltage	The component of output voltage ripple as related to input line frequency is less than 2% $_{RMS}$.

Table 3-3. *Electrical Specifications (Continued)*

Accuracy of All Analog Signals	±1% of the actual value (V, kW, or A) or ±0.2% of the full scale value, whichever is greater
Power Factor	> 0.9 for loads greater than 2 kW
Standard Output Range (full power)	Side A:10 kW over the 300-to-700-VDC range, with a maximum current of 33 A Side B: 6 kW over the 400-to-1000-VDC range, with a maximum current of 15 A
Usable Output Range	See Figure 3-1 on page 3-6 and Figure 3-2 on page 3-7.
Impedance Range	See Figure 3-3 on page 3-8 andFigure 3-4 on page 3-8.
Accuracy of User-Defined Limits	
Current	0 to 5% over the limit from 10 to 100% of full rated output
Voltage	0 to 5% over the limit from 10 to 100% of full rated output
Power	0 to 5% over the limit from 10 to 100% of full rated output
Readback Accuracy	Power is displayed as a simple multiplication of P=V*I. With supplies operated in low impedance loads (high current), a simple 1 V change could induce up to a 50 W change in power. Therefore, the readback accuracy may be greater than 1% in low impedance situations.
Analog Interface Scaling	Side A: Analog input and output signals are 0 to 10 V full scale for power 0 to 10 kW. Voltage readback is 0 to 10 V full scale for voltage 0 to 1000 V. Current readback is 0 to 10 V full scale for current 0 to 40 A. Side B: Analog input and output signals are 0 to 10 V full scale for power 0 to 6 kW. Voltage readback is 0 to 10 V full scale for voltage 0 to 1000 V. Current readback is 0 to 10 V full scale for 0 to 20 A.
Output Polarities	Negative output only. You must ground the positive output lead to the chamber ground. If a positive output connection is attempted the power supply will indicate a ground fault at approximately 40 V.

Pinnacle 10 kW, 300-700 V Output Power Range
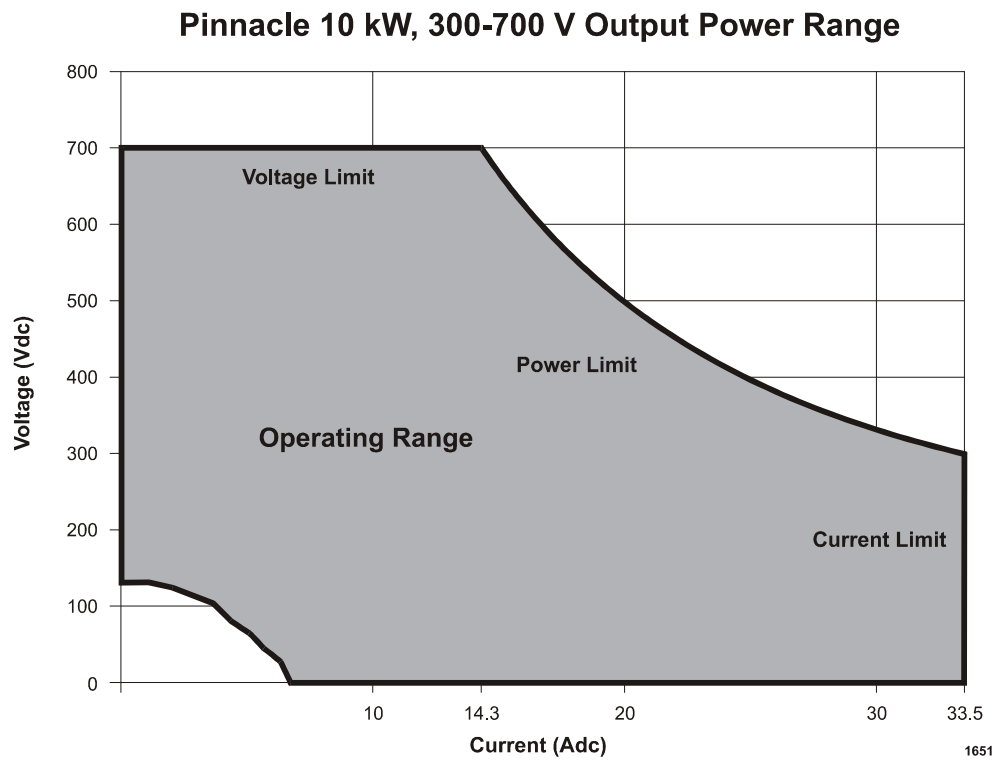
Figure 3-1. *Side A: 10 kW (300-700 V) operating range*

Pinnacle 6 kW (400-1000 V) Output Power Range
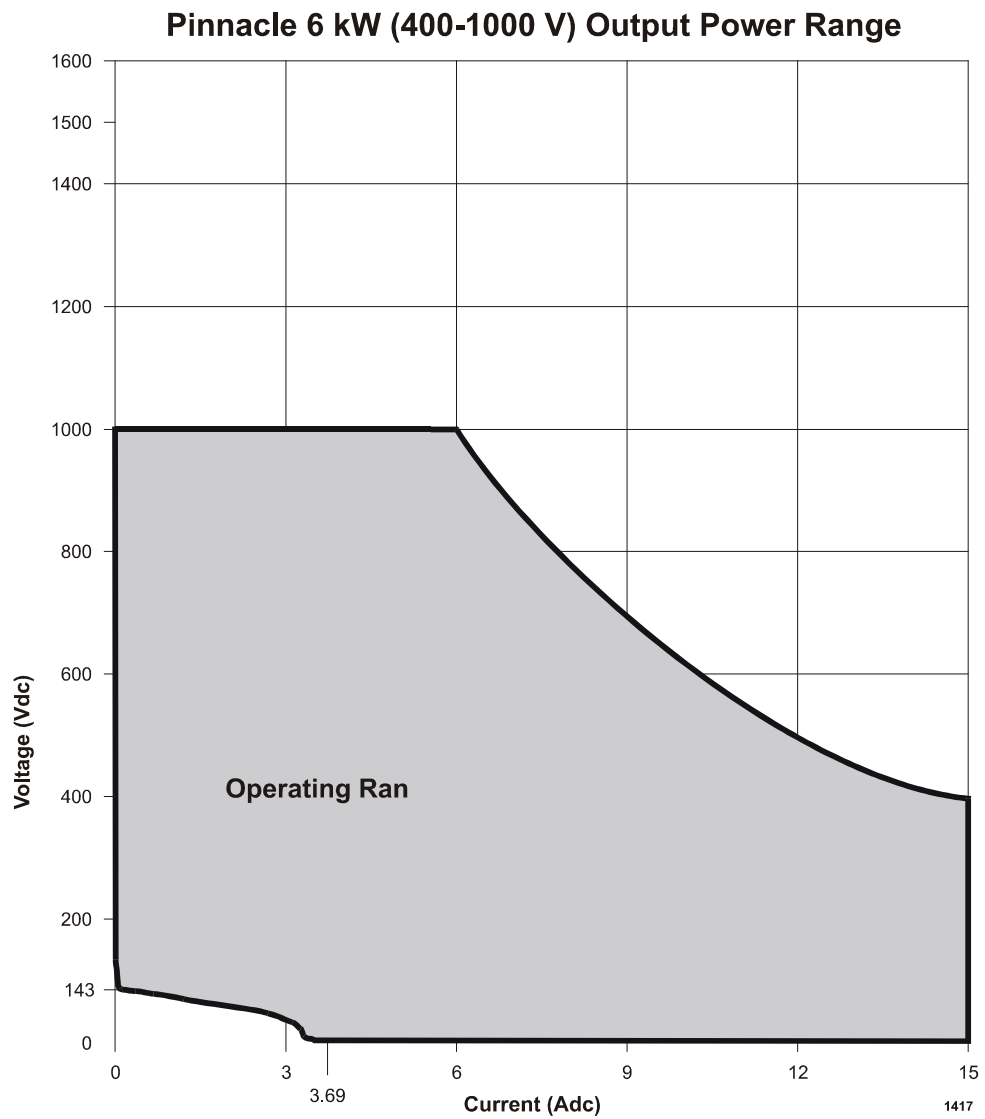
Figure 3-2. Side B: 6 kW (400-1000 V) Operating range

Pinnacle 10 kW, 300-700 V Output
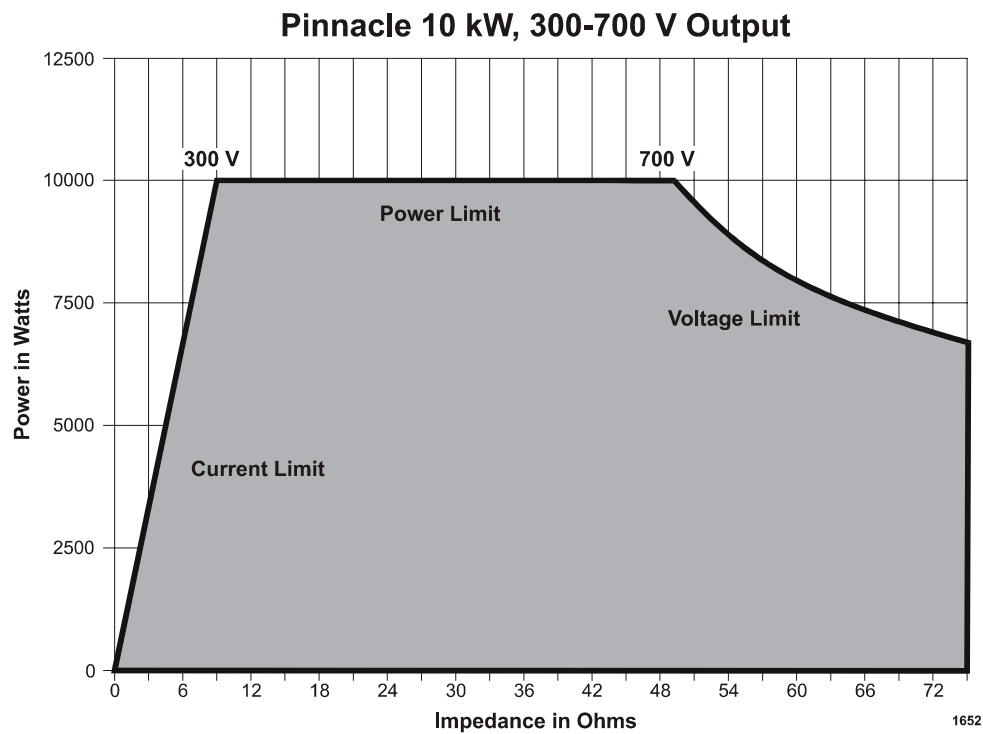
Figure 3-3. *Side A: 10 kW impedance range*

Pinnacle 6 kW (400-1000 V)
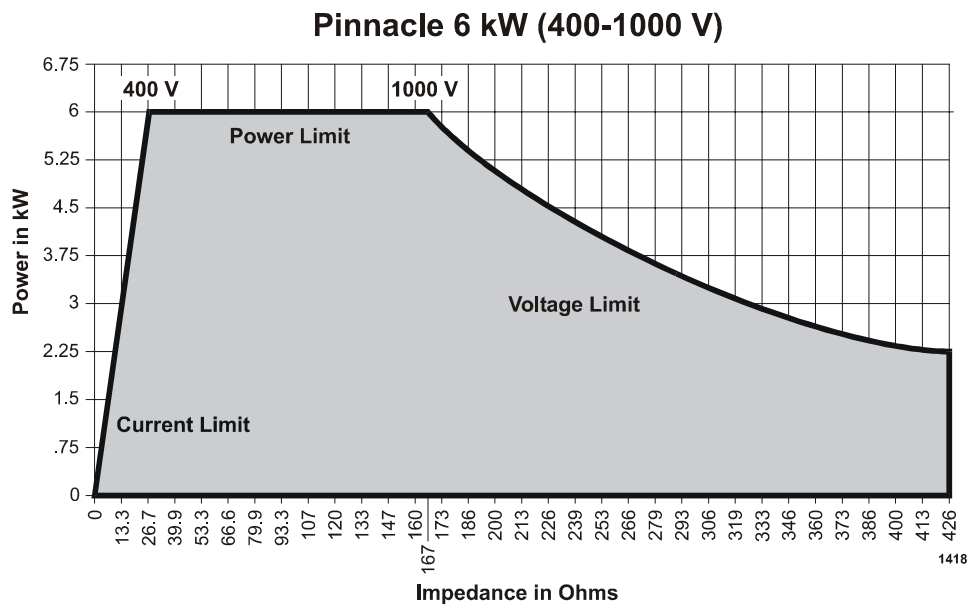
Figure 3-4. *Side B: 6 kW (400-1000 V) Impedance range*

ENVIRONMENTAL SPECIFICATIONS

The following table lists the environmental specifications.

Table 3-4. Climatic Specifications

	Temperature	**Relative Humidity**	**Air Pressure**
Operating	Class 3K3 +5°C to +40°C +41°F to +104°F	Class 3K3 5% to 85% [Note 1] +1 g/m^3 to +25 g/m^3	Class 3K3 80 kPa to 106 kPa 800 mbar to 1060 mbar (approximately 2000 m above sea level)
Storage	Class 1K4 -25°C to +55°C -13°F to +131°F	Class 3K3 5% to 85% +1 g/m^3 to +25 g/m^3	Class 3K3 80 kPa to 106 kPa 800 mbar to 1060 mbar (approximately 2000 m above sea level)
Transportation	Class 2K3 -25°C to +70°C -13°F to +158°F	Class 2K3 95% [Note 2] +60 g/m^3 [Note 3]	Class 2K3 66 kPa to 106 kPa 660 mbar to 1060 mbar (approximately 3265 m above sea level)
[Note 1] Non-condensing [Note 2] Maximum relative humidity when the unit temperature slowly increases or when the unit temperature directly increases from -25°C to +30°C [Note 3] Maximum absolute humidity when the unit temperature directly decreases from +70°C to +15°C			

COOLANT SPECIFICATIONS

Table 3-5. *Coolant Specifications*

Coolant Temperature	Air (gas) minimum 0°C, maximum 35°C.
Pollution Degree	Install and operate this device only in a pollution degree 1 environment, which means an indoor location such as a computer room, office, or factory floor where either no pollution or only dry, non-conductive pollution occurs. (The pollution has no effect on operation.)
EMI/EMC	Tested for electromagnetic compatibility. See the "Safety/Compliance" section of the "Introduction" chapter and the declaring letter for specific standards.
Noise	Noise generated by this unit is 71.5 dB (A) at a 1 m distance

Chapter

4

I/O Communication and Control

USER PORT

The User port allows you to control the Pinnacle unit through a remote controller. The connector is a 15-pin, subminiature-D, female connector (see the following illustration).

Pin 8   Pin 1

1061
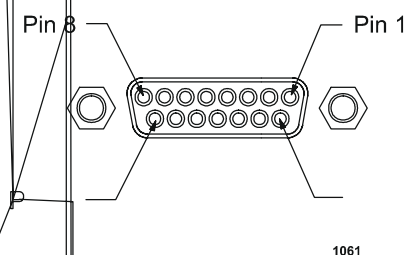
Figure 4-1. *15-pin User port*

You may operate the Pinnacle unit solely through the 15-pin User port. User port operation does not require connection to a DeviceNet network.

Installation

Note: Signals at the User port can be sensitive to environmental noise. We recommend that you take standard preventative measures against electro-magnetic interference (EMI), including using shielded cabling on the User port.

Refer to the pin descriptions on the following pages when connecting your remote controller to the User port. Use shielded cabling to avoid EMI problems.

If you have a Pinnacle Active Remote Panel and you want to operate the Pinnacle supply from the User port, you must set the control mode for USER on the control panel.

Signals

The User port is primarily an "analog" interface. Signal descriptions appear in the following table. Note that a ".A" suffix appended to a pin name indicates an analog signal; a ".D" suffix appended to a pin name indicates a digital signal. An overline on a signal name (for example, $\overline{OUTPUT\ ENABLE.D}$) indicates that the signal is true when low.

.

> ⚠ **DANGER:**
>
> **Power down the Pinnacle unit and take proper ESD precautions before removing the unit's top cover to position jumpers. Failing to power down the unit in this case could result in death or severe personal injury. Failing to take proper ESD precautions in this case could result in damage to the unit.**

Pin-description Table

The User port has priority for selecting targets, even when the unit is in local or host control. Thus to select targets from the active front panel, the Pinnacle Active Remote Panel, or a host computer connected to the host port, you must set the target to 1 at the User port. Leaving the target bits open or leaving the User port pins unconnected causes the target selection at the User port to default to 1.

Table 4-1. *User Port Pin Descriptions*

Signal Pin	Return Pin	Pin Name	Signal Type	Description
1	10, 13, 14, 15	*+24V*	Input	This pin is the collector side of the opto-couplers for status LEDs
2	6	*VOUT.A*	Output	This pin provides a fully buffered 0 to 10 V signal representing output voltage: 10 V = 1000 VDC. When the open circuit output voltage is 1500 VDC, the voltage on pin 2 is 12 VDC. It will sink and source to 10 mA; its impedance is 100 Ω

Table 4-1. _User Port Pin Descriptions (Continued)_

Signal Pin	Return Pin	Pin Name	Signal Type	Description
3	6	_POUT.A_	Output	This pin provides a fully buffered 0 to 10 V signal representing output power: 10 V ±1% = 20,000 W in a single unit system (that is, without any slaves connected). It will sink and source to 10 mA; its impedance is 100 Ω.
4	9	$\overline{OUTPUT}$ $\overline{ENABLE.D}$	Input	This signal is used to turn on output power from the 15-pin User port. Closure between $\overline{OUTPUT}$ $\overline{ENABLE.D}$ and _OUT ENABLE COM.D_ (pin 9) will turn on output power.
5	6	_XPROG.A_	Input	This signal is the 0 to 10 V analog setpoint input which is sent through the custom CMR buffer. 1 to 10 V = 0 to full scale for each regulation mode.
6	n/a	_COM.A_	n/a	This signal is used as a remote ground. _VOUT.A_ (pin 2), _POUT.A_ (pin 3), and _XPROG.A_ (pin 5) should be referenced to this pin.
7	8	$\overline{PWRON.D}$	digital output	When output power is enabled, a contact closure between pin 7 and pin 8 occurs. Use 0.5 A maximum for this readback.
8	n/a	_PWRON COM.D_	n/a	This signal is the return for pin 7.
9	n/a	_OUT ENABLE COM.D_	n/a	This signal is the return reference for $\overline{SETPOINT.D}$, $\overline{OUTPUT\ ENABLE.D}$, and $\overline{OUTPUT.D}$ (pins 1, 4, and 13).

Table 4-1. *User Port Pin Descriptions (Continued)*

Signal Pin	Return Pin	Pin Name	Signal Type	Description
10	n/a	*MOD GREEN*	Output	This pin is the emitter side of an opto-coupler (for MOD LED).
11	12	*$\overline{INTERLOCK.}$ $\overline{D}$*	Input	This digital signal provides a safety interlock. Closure between pins 11 and 12 enables the AC input power contactor.
12	n/a	*$\overline{INTLK\ COM.D}$*	n/a	This signal is the return reference for the interlock signal on pin 11.
13	n/a	*NET GREEN*	Output	This pin is the emitter side of an opto-coupler (for NET LED).
14	n/a	*MOD AMBER*	Output	This pin is the emitter side of an opto-coupler (for the MOD LED).
15	n/a	*NET AMBER*	Output	This pin is the emitter side of an opto-coupler (for the NET LED).

DEVICENET™ PORT

The rear panel of your Pinnacle unit features DeviceNet port for interfacing with a DeviceNet network. The DeviceNet port is a round, five-pin, male micro connector, which is electrically isolated from the power supply (see Figure 4-2).

Note: Dual Pinnacle units (units containing two, seperate inverters) share the common DeviceNet network micro connector, *but each side is controlled and operated independently through this port*. The following discussion describes the operation of one side of the unit. The other side operates the same way.

The following paragraphs describe the interface and the associated rotary switches and LEDs.
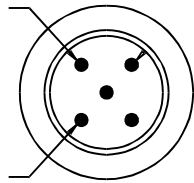
Figure 4-2. *DeviceNet*^{TM} *port with pin designations*

Installation

Refer to the following pin descriptions when connecting to the DeviceNet port. Use the appropriate female, micro connector and cable. See the DeviceNet Specification (revision 2.0) from the Open DeviceNet Vendor Association, Inc. for specifics on the mating connector and cable. Use the rotary switches to select a baud rate and set the unit address (MAC ID).

PIN DESCRIPTIONS

This table lists the pin numbers and DeviceNet pin names. See the DeviceNet Specification (revision 2.0) for definitions of these pin names.

ROTARY SWITCHES: BAUD RATE AND ADDRESSING

The DeviceNet interface features three rotary switches, located on the rear of the Pinnacle unit, which are read each time the DeviceNet interface powers up (see Figure 4-3).

Use the **DATA RATE** switch to select a baud rate: 125, 250, or 500 kbaud
(0 = 125, 1 = 250, 2 = 500 kbaud). The default is 500 kbaud. A switch setting in the
"PGM" region lets you configure the baud rate via DeviceNet.

Note: If your dual Pinnacle unit has two DeviceNet cards (one for each side), it is
important that you set the **DATA RATE** for both sides to the same setting as the
DeviceNet network setting. Any card not set to the network setting will fault
when the network is brought up.
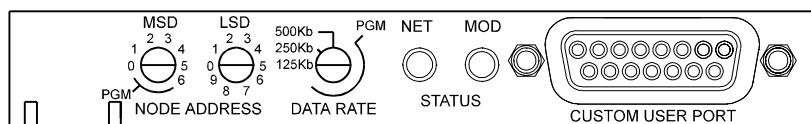
Figure 4-3. *DeviceNet rotary switches and LEDs*

Use the **NODE ADDRESS** rotary switches, **MSD** and **LSD**, to select the unit's
address (MAC ID). MAC IDs 0 through 63 are valid. Use the **MSD** switch to select
the MAC ID's most significant digit; use the **LSD** switch to select the MAC ID's least
significant digit. Switch settings greater than 63 (or in the "PGM" region of the **MSD**
switch) let you configure the MAC ID via DeviceNet.

Note: If your dual Pinnacle unit has two DeviceNet cards (one for each side), it is
important that you set the combined **NODE ADDRESS** of the first card to a
different setting than the combined **NODE ADDRESS** of the second card. If
you do not, one side will fault when the network is brought up.

Operation

You may operate your Pinnacle unit either through the 15-pin User port (**user** control
mode) or through the DeviceNet port (**host** control mode). To operate your Pinnacle
unit through the DeviceNet port, you also must have a connection to the 15-pin User
port. DeviceNet operation entails the use of User port pins 11 and 12.

For best results during DeviceNet operation, do *not* create a connection between pins
4 and 9 on the 15-pin User port. Closing and opening a connection between these two
pins overrides output **on** and **off** signals from DeviceNet.

When the Pinnacle unit powers up, it defaults to **user** control mode and **power**
regulation mode. Engaging DeviceNet places the unit in **host** control mode and **power**
regulation mode.

Before operating your Pinnacle unit through the DeviceNet port, ensure that your
network connects with User port pins 11 and 12 as well as with the DeviceNet port.
(But ensure that no connection exists between pins 4 and 9 on the User port.) Also

ensure that you have selected an appropriate MAC ID and baud rate. Finally, ensure that you have read the following information about command and respond messages and the DeviceNet LEDs.

POLL COMMAND MESSAGE

The Pinnacle DeviceNet interface uses DeviceNet's Group 2 I/O Poll Command message (and the associated Group 1 I/O Poll Response message) to transfer low-level I/O data between the device (slave) and the master. For more information about this message, refer to section 7-6 of the DeviceNet specification (revision 2.0 or later). The following table represents the structure of the poll command message.

Table 4-3. Structure of the poll command message

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Power Output Setpoint AO (LSB)							
1	0*	0*	0*	0*	Power Output Setpoint AO (MSB)			
2	Ramp Rate Setpoint AO (LSB)							
3	0*	0*	0*	0*	Ramp Rate Setpoint AO (MSB)			
4								PO

Note: In Bit 0 of Byte 4, PO refers to Power On. In this bit, 1 = turns on the unit's output; 0 = turns off the units output.

Note: The 16-bit Power Output value (AI/AO) is shifted right four bits, and the remaining four bits are filled with 0s. This changes the 16-bit AO to a 12-bit AO with a value of 10 V = OFFF$_{hex}$.

Scaling

Parts of the message structure are based on binary representations of analog voltages. Thus they have analog scaling associated with them.

The scaling for Power Output is 0 to 10 V, where 10 V = the full rated output power capability of the Pinnacle 300 power system (master and slave units). Do not reset a value higher than the power system's maximum output power capability. (Such requests are always limited to the maximum output power capability of the power system.) For information about determining your power system's maximum output capability, see "Explicit Messaging" on page 4-9 .

The scaling for the Ramp Rate Setpoint (ramping-to-setpoint rate) is also 0 to 10 V as follows:

- 10 V = 1 x power output setpoint per second

- 8 V = 0.8 x power output setpoint per second

- 5 V = 0.5 x power output setpoint per second

- 2.5 V = 0.25 x power output setpoint per second
- 0 V = No ramping rate specified; the Pinnacle unit ramps as fast as it can

If you request a ramping-to-setpoint value that exceeds 10 V, the setpoint will be limited to the equivalent of 10 V.

Ramping

The Pinnacle unit examines the ramping-to-setpoint rate only if the output power setpoint has been set to a new value. Ramping will begin again at 0 after an off-on sequence has occurred.

RESPONSE MESSAGE

The following table represents the structure of the response message.

Table 4-4. Structure of the poll command message

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Power Output AI (LSB)							
1	0*	0*	0*	0*	Power Output AI (MSB)			
2	Voltage Output AI (LSB)							
3	0*	0*	0*	0*	Voltage Output AI (MSB)			
4	Current Output AI (LSB)							
5	0*	0*	0*	0*	Current Output AI (MSB)			
6	Ramp Rate Setpoint AI (LSB)							
7	0*	0*	0*	0*	Ramp Rate Setpoint AI (MSB)			
8				INTS	ARCD	TS	SPS	POS

Note: The 16-bit Power Output value (AI) is shifted right four bits, and the remaining four bits are filled with 0s. This changes the 16-bit AI to a 12-bit AI with a value of 10 V = OFFF$_{hex}$.

Note: For Byte 8, the abbreviations have the following meanings:

- POS stands for Power On Status: 1 = output on; 0 = output off
- SPS stands for Setpoint Status: 1 = setpoint reached; 0 = setpoint not reached
- TS stands for Temperature Status: 1 = good; 0 = over-temperature condition
- ARCD stands for Arc Detected: 1 = on; 0 = off
- INTS stands for Interlock Status: 1 = satisfied; 0 = open

Scaling

Parts of the Message structure are based on binary representation of analog voltages. Thus they have analog scaling associated with them.

The scaling for power output is 0 to 10 V, where 10 V = the full rated output power capability of the Pinnacle power system (master and slave units). The read back is limited to 10 V (0FFF$_{hex}$), even in those cases where output may temporarily exceed the maximum output capability of the power system.

The scaling for voltage output is 0 to 10 V, with 10 V = 1,000 V. The read back is limited to 10 V (0FFF$_{hex}$), even in those cases where output may temporarily exceed 1,000 V.

The scaling for current output is 0 to 10 V, with 10 V = the maximum output current capability of the unit. The read back is limited to 10 V (0FFF$_{hex}$), even in those cases where output may temporarily exceed the maximum output current capability.

EXPLICIT MESSAGING

The Pinnacle DeviceNet interface supports explicit messaging so that you can receive information about two power system parameters: maximum power and maximum current. Use the following Class Code 64 (40$_{hex}$), Instance 1 attributes to retrieve this information:

Attribute	Access	Name	Type	Value
6	Get	Max Power	UINT	(1)
7	Get	Max Current	UINT	(2)

Note: The Max Power attribute returns a value in Watts if the unit is operating stand alone. For example, a value of 20,000 equates to 20,000 W. The Max Power attribute scaling is Watts x 10 if the unit is operating as a master/slave set. In this case, a value of 2,000 equates to 20,000 W.

Note: The Max Current attribute returns a value in Amperes with 2 decimal places implied. For example, a value of 8,000 equates to 80 A.

For more information about this type of messaging, refer to section 4-2 of the DeviceNet Specification (version 2.0 or later). The following Common Services specifications apply:

Service Code	Class	Instance	Service Name
14 (0E$_{hex}$)	Yes	Yes	Get_Attribute_Single

Rear Panel LEDs

The rear panel of the Pinnacle unit features two bi-color LEDs (see Figure 4-3). One is labeled **MOD** and indicates module status. The other is labeled **NET** and indicates network status.

MODULE STATUS LED

The **MOD** bi-color (amber/green) LED provides device status. It indicates whether the device has power and is operating properly. The following table shows the LED's various states and their meanings.

Table 4-5. MOD Status LED

If the LED is	the state indicated is	which means that
Off	No power	the unit is not receiving power.
Green (steady)	Operational	the unit is operating normally.
Flashing Green	Standby	the unit needs maintenance because the configuration is missing, incomplete, or incorrect.
Amber	Unrecoverable Fault	the unit has experienced a fault from which it cannot recover; you may need to replace the unit.
Flashing Amber/ Green	Device Self-Testing	the unit is running self diagnostics

For information on LED flash rates, refer to section 8.2.8 of the DeviceNet Specification (revision 2.0).

For information about Module Status LED indications during power-up, refer to Section 8.2.4 of the DeviceNet Specification (revision 2.0).

NETWORK STATUS LED

The **NET** bi-color (amber/green) LED indicates the status of the communication link. The following table shows the LED's various states and their meanings.

Table 4-6. Network Status LED

If the LED is	the state indicated is	which means that
Off	No power	the unit is not on-line because: 1) it has not completed the Dup_MAC_ID test yet; or 2) it is not receiving power (check the **MOD** LED).
Green (steady)	Link Okay	the unit is on-line and allocated to the master.
Flashing Green	On-line, Not Connected	the unit is on-line but has no connections in its existing state because: 1) the unit has no established connections to other nodes; or 2) the unit is not allocated to the master.

Table 4-6. Network Status LED (Continued)

If the LED is	the state indicated is	which means that
Flashing Amber	Connection Time-out, Critical Link Failure	one or more I/O connections are in the timed-out state.
Amber	Critical Link Failure	communication has failed; that is, the unit has detected an error that has made it incapable of communicating on the network. *Note:* If you have a dual Pinnacle unit, the causes of this failure may be: 1) the two DeviceNet cards are not set to the same Data Rate as the network; or 2) the two DeviceNet cards have the same Node Address.

For information about Module Status LED indications during power-up, refer to Section 8.2.4 of the DeviceNet Specification (revision 2.0).

PASSIVE DISPLAY PANEL

The passive front panel and remote passive panel let you monitor power, current, or voltage; receive error codes; and review several other conditions shown by the LEDs.

Note: The master/slave functions listed in this section apply only to Pinnacle supplies with a master/slave Host card installed. Additionally, dual output Pinnacle units can *not* be configured for master/slave operation.

Display

At any time while the Pinnacle supply is operating, you can press the DISPLAY buttons to left of the four-digit display to find the number of kilowatts, volts, or amps being delivered.

This display also shows error codes when a fault or software error has occurred. For a detailed explanation of these codes and other troubleshooting materials, see the "Troubleshooting" chapter.

When only a Passive Front Panel (PFP) is available, the Pinnacle unit will display 4 character strings on start up to identify personality cards installed in the unit. A code will flash once for each card installed. The following table describes the strings:

Table 4-7. Passive Display Panel Codes

PFP Display String	Personality Card
H----	No cards
H-01	Dual User card
H-03	PROFIBUS card
H-04	Host Protocol Translator card
H-05	Single User card
H-18	AE Bus card
H-30	DeviceNet card

LEDs

Table 4-8. Display Panel LEDs

POWER ON	Illuminates green when input power is on
OUTPUT	Illuminates green if output power is on
SETPOINT	Illuminates green if the Pinnacle supply is operating within setpoint; accuracy is within 0.4% of full scale or 2% of setpoint, whichever is greater
INTERLOCK	Illuminates green if all interlock conditions have been met
BUS FAULT	Illuminates green when a bus fault occurs

Table 4-8. Display Panel LEDs (Continued)

OVERTEMP	Illuminates green if the Pinnacle supply has exceeded the maximum operating temperature
ARC	After the output has been turned off, this LED illuminates green for a predetermined time (normally 100 ms) if the hard arc count limit was reached or exceeded during the previous run. If your unit has been configured for signaling on every hard arc, this LED will blip for a predetermined time for every hard arc detected by the unit. If another hard arc is detected before the last blip is complete, the blip pulse width will be refreshed to the full width.

ACTIVE FRONT PANEL/ PINNACLE REMOTE PANEL

The Pinnacle supply presents a broad array of features and settings that you can easily control through the Pinnacle Remote Active Panel. If you are using the Pinnacle Remote Active Panel, first ensure that it has been properly connected to the Pinnacle supply; installation information appears in the following section.

Connecting to the Remote Active Panel

The 9-pin, male, subminiature-D connector labeled REMOTE ACTIVE PANEL on the rear of the Pinnacle power supply lets you connect the supply to the Pinnacle Remote Active Panel.
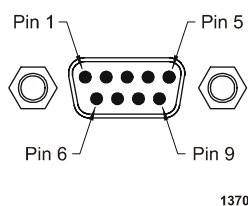
Figure 4-4. Remote active panel connector

The pin descriptions for this connector appear in the following table. Please see the installation instructions that follow the table for further information.

Table 4-9. Remote Active Panel Pin Descriptions

Pin	Description
1	Do not connect
2	Do not connect

Table 4-9. *Remote Active Panel Pin Descriptions (Continued)*

Pin	Description
3	Do not connect
4	Do not connect
5	Ground
6	TR-
7	TR+
8	R-
9	R+

⚠️ **CAUTION:**

When installing the Pinnacle Remote Active Panel, do not connect to or disconnect from a Pinnacle unit that is receiving AC input power. Damage to equipment could result. Before connecting or disconnecting the Pinnacle Remote Active Panel, first turn off the AC input power.

To connect your Pinnacle power supply to the Pinnacle Remote Active Panel:

1. Turn off AC input power to the Pinnacle unit.

2. Connect the cable between the REMOTE ACTIVE PANEL connector on the Pinnacle supply and the Pinnacle Remote Active Panel.

3. Turn on AC input power to the Pinnacle unit.

Understanding the Panel

CONTROL KEY

To control your Pinnacle supply from the panel, select local mode by pressing the CONTROL key on the panel until the LOCAL LED lights. Placing the unit in local mode gives you full access to the front panel menu (see the figure in "Control Panel Interface" on page 4-17).

To control the Pinnacle supply from the Serial interfaces or the DeviceNet port, press the CONTROL key until the HOST LED lights. To control the Pinnacle supply from the User port, press the CONTROL key until the USER LED lights. When the Pinnacle unit is in host or user control mode, you can view all the menu items, but you cannot modify parameters or lock the display.

OUTPUT DISPLAY SCREEN

The first screen that appears on the panel's vacuum fluorescent display when you power up is the "output display screen." See "Two-Line Output Display Screen" on page 4-18 for more information.

Viewing Output Information

The output display screen shows the actual output level in volts, amps, and watts. (See the front panel drawings at the end of the "Installation" chapter.) The output display screen also displays the setpoint.

Selecting Setpoint

To program the setpoint level from an active control panel, use the panel's CONTROL key to select local control mode (the LOCAL LED will light). (See "Setting the Setpoint" on page 4-43.) Display the setpoint menu by pressing the right-most soft key until Side A setpoint displays. Then rotate the MODIFY knob until the setpoint you want is displayed. (See below for more information about the MODIFY knob.)

SOFT KEYS

The five unlabeled soft keys directly below the vacuum fluorescent display let you select menu choices. Menu choices appear on the second line of the display. Since different selections (different menu levels) are displayed at different times, this manual refers to the soft keys by whichever terms are displayed above them. For example, you are instructed to press the ARC soft key when ARC is the menu choice directly above that particular key. See Figure on page 4-12.

MODIFY KNOB

Use the MODIFY knob to change values and move through the menus. When the display screen shows a flashing value, you can change it by rotating the MODIFY knob. In addition, you can use the MODIFY knob to move quickly through the menus. Pressing the MODIFY knob once moves you up one level in the menu. Pressing it twice quickly moves you all the way out of the menu to the output display screen.

REGULATION SWITCH

At the SETPT menu, choose one of three methods of output regulation (power, current, or voltage) by pressing the REGULATION switch until the relevant LED lights. If you switch from one method to another while output is on, the setpoint in the new regulation method will correspond in value to the output level selected at the time you switched. For example, if the Pinnacle supply is regulating power and the setpoint level is 5,000 W (voltage level is 500 V and current level is 10 A) and you select voltage regulation, the new setpoint will be 500 V.

Note: At the top level menu, the regulation LEDs are not lit, because this is a dual supply.

ON/OFF BUTTONS & LEDS

The ON and OFF switches on the remote panel turn on and off the output power. The relevant LED lights to indicate output is on or off.

Note: At the SETPT menu, only a single side turns on. At all other menu levels, both sides turn on. Pressing the OFF switch turns off both sides regardless of the menu level.

ARC LED

After the output has been turned off, this LED lights green for a predetermined time (normally 100 ms) if the hard arc count limit was reached during the previous run. You define this limit through a control panel or with command **9**. If your unit has been configured for signaling on every hard arc, this LED will blip for a predetermined time (normally 100 ms) for every hard arc detected by the unit. If another hard arc is detected before the last blip is complete, the blip pulse width will be refreshed to the full width.

CONTROL PANEL INTERFACE

Your Pinnacle unit may have either an active front panel, which is an integrated part of the unit, or an active remote panel, which is connected to the DISPLAY port on the rear panel of the unit.

Note: This manual uses the term "control panel" to refer to either of these panels since they function identically.

An active control panel has three main sections:

- ON and OFF switches at the far left of the panel
- CONTROL and REGULATION switches at the far right of the panel
- A two-line display, five soft keys, and a MODIFY knob
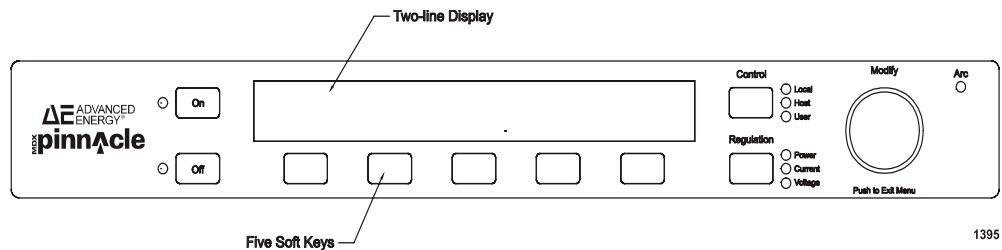
Figure 4-5. *Control panel*

Output Power Switches

Use the following switches to turn output power on and off.

ON	Turns on output power if the control panel has control of the on/off function and all interlock conditions are satisfied.
OFF	Turns off output power, no matter which interface is currently controlling the unit.

Control Switch

Use the following switches to select the controlling interface.

LOCAL	Takes back control from the serial port or User port and gives it to the control panel.
HOST	Gives control to the host computer through the serial port.
USER	Gives control to the controller through the User port. *Note:* A User card must be installed for this switch to be active.

Regulation Switches

Use these switches to select the method of output regulation when the control panel has control.

POWER	Specifies that the method of output regulation is power.
CURRENT	Specifies that the method of output regulation is current.
VOLTAGE	Specifies that the method of output regulation is voltage.

Two-Line Output Display Screen

The display screen displays two lines of information. When you first power up, the display shows the top level (line 1), which displays the actual output level of Side A in volts, amperes, and watts. The setpoint and program source are also shown. The second line shows Side B information.

0 V	0.00 A	0.00 W	A: SETPT=	0W
0 V	0.00 A	0.00 W	B: SETPT=	0W

Soft Keys

Use the soft keys to select whichever menu functions are shown immediately above them on the two-line display. "Passive Display Panel" on page 4-12 explains how to perform these operations from the Pinnacle control panel.

Note: If you're at the top level, you can press any soft key to make the menus appear.

Modify Knob

Use the MODIFY knob with the soft keys to make selections and modify values that appear on the two-line display.

CONTROL PANEL CONTROLS

Use the MODIFY knob and the five unlabeled soft keys that are directly below the display to select parameters and modify values. To changes parameters using the menu, the Pinnacle unit must be in local control mode (the LOCAL LED will be lit).

Note: When the Pinnacle unit is in User or Host (serial) mode, you can view all the menu items, but you cannot modify any of the items or lock the unit. If you switch the Pinnacle unit to User mode while you are viewing an item in the menu, you are returned to the output display screen immediately.

When the output display is showing, you can press any of the soft keys to display the main menu. The main menu contains three menu selections, which are shown in Figure . Generally, pressing a soft key causes another level of menu choices to display (for example, MONITOR, LIMITS, ARC, and CONTROL display if you press the PROCESS soft key).

SERVICE	SUPPLY	PROCESS

Figure 4-6. *Control panel main menu functions*

As you press soft keys and move through the menu levels, the top line of the output display screen displays the path of the menu in the upper, left-hand corner of the display screen.

A parameter flashes if it can be modified; make such modifications with the MODIFY knob. Pressing the ENTER soft key enters the modification into nonvolatile memory. You can press the MODIFY knob at any time to cancel what you are doing (leave the parameter(s) unchanged) and return to the output display screen.

If a fault exists or the panel is locked, the soft keys are locked out until you clear the fault. See Chapter 7 "Troubleshooting And Customer Support" for a list of fault messages.

UNDERSTANDING THE MENU OPTIONS

Pressing any soft key will bring up the main menu tree. When at the top level, you have three menu options:

- Service

- Supply

- Process

From the Service menu, you can access diagnostic information. From the Supply menu, you can modify supply-specific parameters, and from the Process menu, you can access options that affect your process or monitor your process. To select a menu option, press the soft key below the menu option. See the menu maps for a graphical representation of the menu options.
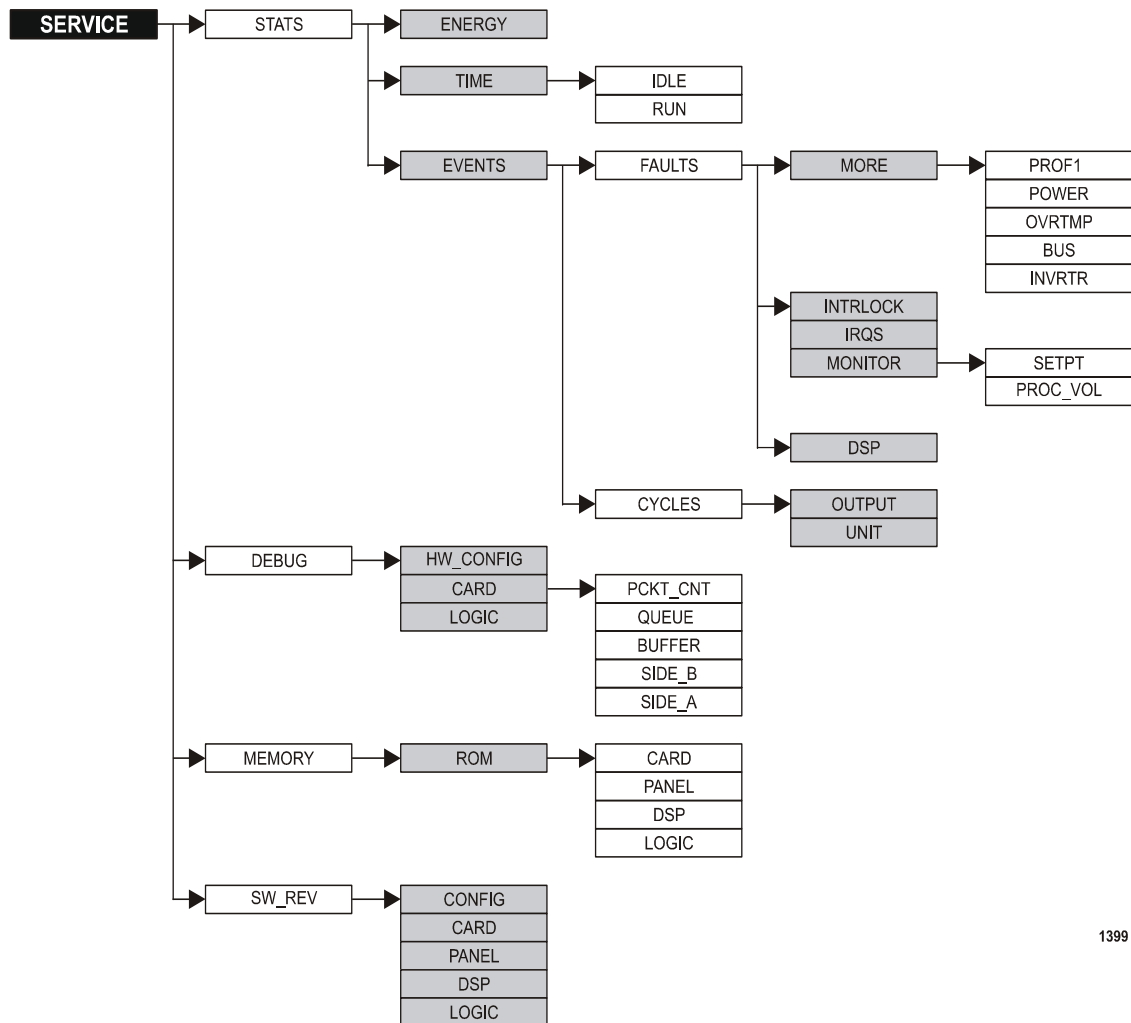
Figure 4-7. *Service menu map*
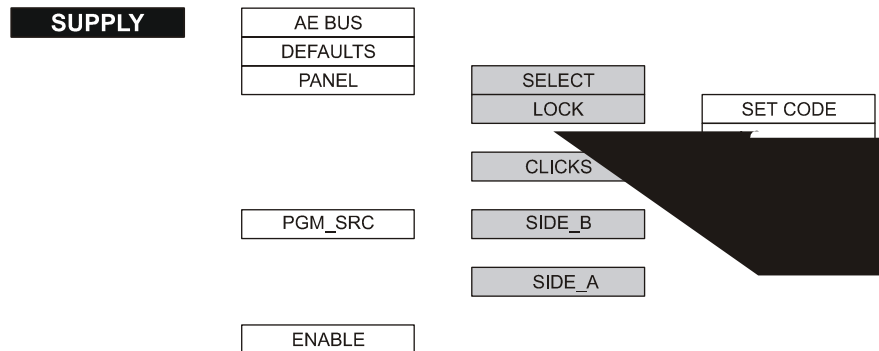
Figure 4-8. *Supply menu map*
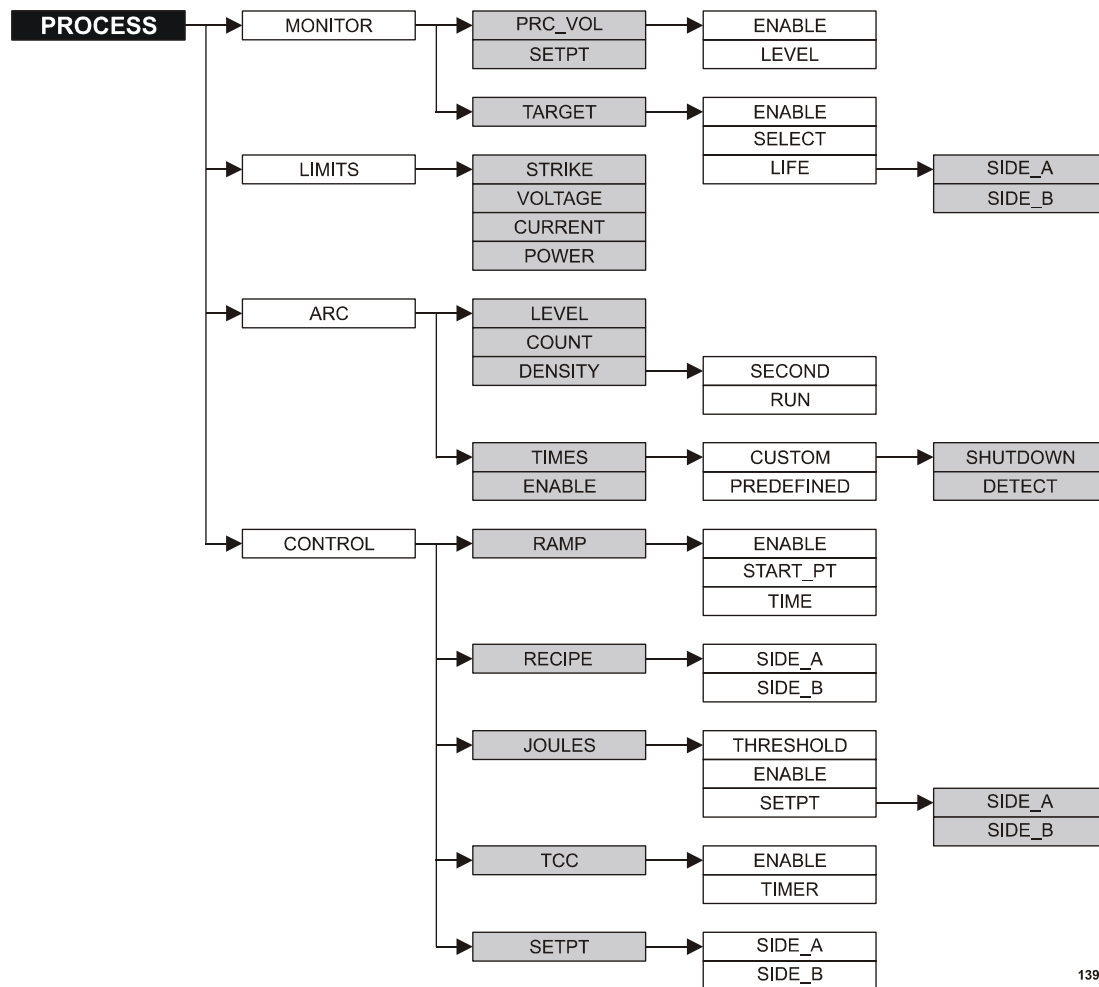
Figure 4-9. *Process menu map*

USING THE SERVICE FUNCTIONS

Use this option to view diagnostics and software versions of your supply. The menu options are:

- STATS: supply statistics
- DEBUG: debug screens
- MEMORY: ROM CRC checksums
- SW_REV: software revision numbers

Checking Service-type Statistics

SERVICE → STATS

Use this option to check the service-type statistics.

CHECKING THE TOTAL ENERGY OUTPUT

SERVICE → STATS → ENERGY

To check the total energy output to source A or source B:

1. Press SERVICE → STATS → ENERGY.

   ‣ The total energy output for source A and source B appears.

CHECKING THE AMOUNT OF IDLE TIME

SERVICE → STATS → TIME

To check the amount of time (for side A and side B) idle and the amount of time running:

1. Press SERVICE → STATS → TIME.

2. To display the amount of time idle, press the IDLE soft key.

   ‣ The amount of time idle (for source A and source B) appears.

3. To display the amount of time running, press the RUN soft key.

   ‣ The amount of time running (for source A and source B) appears.

CHECKING THE NUMBER OF FAULTS

SERVICE → STATS → EVENTS

To check the number of faults:

1. Press SERVICE → STATS → EVENTS.

   ‣ FAULTS and CYCLES options appear.

2. Press the FAULTS soft key.

3. MORE, INTRLOCK, IRQS, MONITOR, and DSP options appear.

4. If you press MORE, you can check the following faults:

   ‣ PROFI displays the number of PROFIBUS faults

   ‣ POWER displays the number of line power faults.

   ‣ OVRTMP displays the number of over temperature faults.

   ‣ BUS displays the number of bus faults.

   ‣ INVRTR displays the number of inverter faults for each side.

5. If you press INTRLOCK, the number of contactor, user, and cable faults appears.

6. If you press IRQ, the number of predefined and unassigned IRQs appears.

7. If you press MONITOR, you can check the number of setpoint timer faults and process voltage faults for each side.

8. If you press DSP, the number of DSP control and DSP watch dog faults appears.

CHECKING THE NUMBER OF CYCLES

To check the cycles:

1. Press SERVICE → STATS → EVENTS.

   ‣ FAULTS and CYCLES options appear.

2. Press the CYCLES soft key.

   ‣ OUTPUT and UNIT options appear.

3. To get a report of the number of output on events, press the OUTPUT soft key.

4. To get a report of the number of power ups, press UNIT.

Debugging Your Unit

SERVICE → DEBUG

Use this option to check the hardware configuration, installed cards, and logic software options.

CHECKING YOUR HARDWARE CONFIGURATION

SERVICE → DEBUG → HW CONFIG

To find out whether or not a card is installed in slot 1 or 2:

1. Press SERVICE → DEBUG → HW CONFIG.

   ‣ A report of the personality cards installed in the supply in slot 1 and slot 2 appears.

CHECKING YOUR COMMUNICATIONS CARD

SERVICE → DEBUG → CARD

Use this option to find out specific communications debug information:

1. Press SERVICE → DEBUG → CARD.

   Note: Not all cards support this feature.

CHECKING YOUR SOFTWARE LOGIC

SERVICE → DEBUG → LOGIC

Use this option to find out what software logic options are installed.

1. Press SERVICE → DEBUG → LOGIC.

   ‣ A two-byte hex representation of the software options appears.

Checking Your ROM

SERVICE → MEMORY

To perform ROM cyclic redundancy check (CRC) checking:

Note: There is a momentary delay before the CRC will display.

1. Press SERVICE → MEMORY → ROM → CARD.

   Note: Not all cards support this option.

2. To calculate and display the active panel (local or remote) CRC, press PANEL.

3. To calculate and display the DSP CRC, press DSP.

4. To calculate and display the logic board CRC, press LOGIC.

Checking Your Software Versions

SERVICE → SW_REV

To find out the software number and version of your system software components:

1. To display the software version of the configuration, press CONFIG.

2. To display the software version of the cards installed in your unit, press CARD.

3. To display the software version of the active panel software, press PANEL.

4. To display the software version of the DSP software, press DSP.

5. To display the software version of the logic, press LOGIC.

USING THE SUPPLY FUNCTIONS

This option lets you modify specific components and parameters of your supply. The menu options are:

- AEBUS:
- DEFAULTS:
- PANEL:
- PGM_SRC:
- ENABLE:

Setting the AE Bus Timeout

SUPPLY → AE BUS

To set your AE Bus timeout time:

Note: We recommend you keep this value as small as possible to speed up error recovery due to noise.

1. Press SUPPLY → AEBUS.

2. Rotate the MODIFY knob to adjust the AE Bus time out value (in 10 ms increments).

3. Press ENTER to accept and exit.

Setting the Supply Parameters

SUPPLY → DEFAULTS

To set all your supply parameters to the defaults and then store them in non-volatile memory:

1. Press SUPPLY → DEFAULTS.

2. Rotate the MODIFY knob to select Yes or No.

3. Press ENTER to accept and exit.

4. Cycle power on the supply for the defaults to take effect.

Setting the Panel Mode

SUPPLY → PANEL

Use this option to select between a remote and local control panel, lock the control panel, set the lock code, or set the encoder rate for the knob clicks.

SELECTING REMOTE OR LOCAL MODE

SUPPLY → PANEL→ SELECT

To switch between the remote active panel and the local active panel:

1. Press SUPPLY → PANEL → SELECT.

2. Rotate the MODIFY knob to display Yes or No, depending on whether or not you want to switch to a remote/local active panel.

3. Press ENTER to accept and exit.

4. Wait several seconds for verification of switch before using the other control panel.

SELECTING A LOCK CODE

SUPPLY → PANEL→ LOCK

To enter a lock code for locking the active control panel:

1. Press SUPPLY → PANEL → LOCK.

    ‣ SET CODE and LOCK UNIT options appear.

2. To set a lock code, press the SET CODE soft key. If a code is already entered, press LOCK UNIT.

    ‣ Any further menu accesses will require entry of the code.

Note: Cycling power on the supply resets the lock status to UNLOCKED.

SELECTING THE NUMBER OF CLICKS

SUPPLY → PANEL→ CLICKS

The clicks feature specifies the number of high speed counts per click for the MODIFY knob. The value you enter is a multiplier for each click of the knob when you turn the knob quickly. When you turn the knob slowly, the multiplier does not take effect. You can enter any number from one to 40. If you want a displayed value to change slowly as you turn the knob, set the number of counts per click to 1. If you want the value to change quickly, set the number of counts to 40.

To change the number of counts per click:

1. Press SUPPLY → PANEL → CLICKS.

2. Rotate the MODIFY knob to set the number of counts per click.

3. Press ENTER to accept and exit.

Setting the Program Source

SUPPLY → PGM_SRC

The program source (PGM_SRC) feature specifies for each control mode the program source for regulation mode and setpoint information. For each control mode, if the program source is set to internal (INT), the Pinnacle supply uses the information for output regulation mode and setpoint that has been established through either the Pinnacle Remote Active panel or the standard serial port. If the program source is set to external (EXT), the Pinnacle supply uses the setpoint and output regulation mode that has been established through the pins on the User port.

To select the desired source and type:

1. Press SUPPLY → PGM_SRC.

    ‣ SIDE_B and SIDE_A options appear.

2. Press the soft key for the desired side.

⬩ HOST, LOCAL, and USER options appear. Press one of these buttons to toggle between internal and external for that type.

3. Press EXIT.

Note: A User card must be installed in order to alter these settings.

Selecting the Supply to Enable

SUPPLY → ENABLE

In dual supplies, this feature assists in turning on only one side from an active panel since there's only one On button. See PROCESS → CONTROL → SETPT for other methods of turning on the output for a single side.

To select the supply to enable:

1. Press SUPPLY→ ENABLE.

2. Rotate the MODIFY knob to select Yes or No for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select Yes or No for Side B.

5. Press ENTER to accept and exit.

USING PROCESS FUNCTIONS

Use this option to access parameters that control, limit, or monitor your process. The menu options are:

• MONITOR: monitor your process

• LIMITS: set limits

• ARC: set arc parameters

• CONTROL: set process control parameters

Monitoring Your Process

PROCESS → MONITOR

This menu allows you to monitor elements of your process such as the life of your target, how long the process is running out of setpoint, or whether the process voltage drops below its threshold.

ESTABLISHING A MINIMUM PROCESS VOLTAGE

PROCESS → MONITOR→ PRC_VOL

This menu lets you establish a minimum process voltage. To use this feature, you must first enable it and then establish a desired threshold limit. With the process voltage limit feature enabled, the Pinnacle unit waits for the output voltage to first exceed the limit. Once the limit is exceeded, output will remain on until you turn the output off or until the voltage falls below the established limit. If the voltage falls below the limit, output will turn off and error message **E010** for Side A or **E013** for Side B will appear on the display.

To enable and set the process voltage level for Side A:

1. Press PROCESS → MONITOR→ PRC_VOL → ENABLE.

2. Rotate the MODIFY knob to select Yes or No for Side A.

3. Press ENTER twice.

4. Press the LEVEL soft key.

5. Rotate the MODIFY knob to select a process voltage level.

6. Press ENTER twice to accept and exit.

To enable and set the process voltage level for Side B:

1. Press PROCESS → MONITOR→ PRC_VOL → ENABLE.

2. Press the ENTER soft key.

3. Rotate the MODIFY knob to select Yes or No for Side B.

4. Press ENTER.

5. Press the LEVEL soft key.

6. Press ENTER.

7. Rotate the MODIFY knob to select a process voltage level.

8. Press ENTER to accept and exit.

SETTING AN OUT-OF-SETPOINT TIMER

PROCESS → MONITOR→ SETPT

Use this option to enable and set an out-of-setpoint timer. This function lets you indicate how long you want the power supply to tolerate an out-of-setpoint condition before it shuts off output. An out-of-setpoint condition occurs whenever output moves out of a range determined by your selected setpoint (see "Setting the Setpoint" on page 4-43).

Out-of-Setpoint Tolerance Range = Setpoint + 0.4% of full scale or 2% of setpoint, whichever is greater.

When an out-of-setpoint condition occurs, the unit shuts off output and displays error code **E001** for Side A and **E008** for Side B. (See the "Error Codes" section of the "Troubleshooting" chapter for more information about error codes).

To enable the out-of-setpoint timer, follow these steps to select a value in 0.1 s increments. To disable the timer, follow these steps and select a value of 0.

Note: Because the readbacks, which are compared to the setpoint, are filtered in the software, we recommend you do not use this feature for process runs that are less than 1.0 s.

1. Press PROCESS → MONITOR→ SETPT.

2. Rotate the MODIFY knob to adjust the value for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to adjust the value for Side B.

5. Press ENTER to accept and exit.

CHANGING THE TARGET FUNCTIONS

PROCESS → MONITOR→ TARGET

The target functions let you enable or disable the target life counter (ENABLE), change the active target (SELECT), and set the target life (LIFE) in 0.01 kWh increments.

PROCESS → MONITOR→ TARGET → ENABLE

To enable or disable the target life counter for the selected target:

1. Press PROCESS → MONITOR → TARGET → ENABLE.

2. Rotate the MODIFY knob to select Yes or No for side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select Yes or No for side B.

5. Press ENTER to accept and exit.

PROCESS → MONITOR→ TARGET → SELECT

To change the active target life counter:

1. Press PROCESS → MONITOR → TARGET → SELECT.

2. Rotate the MODIFY knob to select the active target number for side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select the active target number for side B.

5. Press ENTER to accept and exit.

   Note: The User port has priority in selecting targets. Thus, if your unit has a user card installed, you must set the target to 1 at the User port if you want to select targets from the serial port, active front panel, or Pinnacle Remote

Active Panel (that is, when the Pinnacle unit is in host or local control mode). Leaving the target bits open or leaving the User port pins unconnected causes the target selection at the User port to default to 1.

PROCESS → MONITOR→ TARGET → LIFE

To set the target life in 0.01 kWh increments:

1. Press PROCESS → MONITOR → TARGET → LIFE.

   ‣ SIDE_B and SIDE_A options appear.

2. Press the soft key that corresponds to the desired side.

3. Rotate the MODIFY knob to select a target life between 0 and 15000.00 kWh (The default is 0).

   ‣ If you are rotating the MODIFY knob slowly, press the appropriate soft key to indicate how quickly you want the display to increment the value (x1000, x100, x10 or x1). Note: If you turn the MODIFY knob quickly, the counts per click setting takes effect.

4. Press ENTER to accept the setting and exit.

This function will also display how much target life is left as the counter decreases.

When the end-of-target-life is reached, the output display screen flashes "EOTL" and the Pinnacle unit continues running until a normal off command is received.

Note: The Pinnacle unit cannot turn back on until the target life is reset or until the target status is disabled or a new active target is selected.

Setting Process Limits

PROCESS → LIMITS

This menu lets you control user-selectable operating limits for the Pinnacle unit: strike voltage and maximum output (voltage, current, and/or power).

Note: Before entering a maximum output limit, consider your system's output impedance and consider how your selected power limits will interact. The unit will limit output when output reaches the first applicable limit.

Note: You cannot set a setpoint greater than the corresponding limit in that regulation mode.

SETTING A STRIKE VOLTAGE LIMIT

PROCESS → LIMITS → STRIKE

This function lets you set the strike voltage limit to high, medium, or low. Refer to Table 1-3 for more information.

Note: The strike limit controls the level of the strike/ignition voltage but also impacts the initial power overshoot experienced when requesting low setpoints. For example, with a strike voltage limit setting of "high," you may observe a significant overshoot when requesting a low power. If ignition is not difficult the user can select "medium" or "low" to reduce the effects of overshoot.

Note: High voltage output units (750–1500 VDC and 1500–3000 VDC) do *not* have strike voltage capability.

To set the strike voltage limit:

1. Press PROCESS → LIMITS → STRIKE.

2. Rotate the MODIFY knob to select HIGH, MEDUIM, or LOW for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select HIGH, MEDIUM, or LOW for Side B.

5. Press ENTER to accept and exit.

Table 4-10. Strike Voltage Limit Settings

Strike Voltage Setting	Low-Z 200–400 VDC	Standard-Z 400–800 VDC	High-Z 400–1000 VDC 500–1000 VDC	High Voltage 750–1500 VDC 1500–3000 VDC
Low	400 V ± 100 V	800 V ± 100 V	1,000 V ± 100 V	Strike voltage not available
Medium	650 V ± 100 V	1,100 V ± 100 V	1,200 V ± 100 V	
High	900 V ± 100 V	1,450 V ± 150 V	1,450 V ± 150 V	

SETTING A MAXIMUM LIMIT FOR OUTPUT VOLTAGE

PROCESS → LIMITS → VOLTAGE

This function lets you set a maximum limit for output voltage. The default (and maximum allowable value) is the maximum rated output for the supply. Accuracy is +0.3% of the full rated output voltage for the supply.

To set the user voltage limit:

1. Press PROCESS → LIMITS → VOLTAGE.

2. Rotate the MODIFY knob to select a value between 0 and the maximum rated output voltage for the supply for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select a value between 0 and the maximum rated voltage for the supply for Side B.

5. Press ENTER to accept and exit.

SETTING THE MAXIMUM LIMIT FOR OUTPUT CURRENT

PROCESS → LIMITS → CURRENT

This function lets you set a maximum limit for output current. The default (and maximum allowable value) is the maximum rated output for the supply. Accuracy is +0.3% of the full rated output current for the supply.

To set the user current limit:

1. Press PROCESS → LIMITS → CURRENT.

2. Rotate the MODIFY knob to select a value between 0 and the maximum rated output current for the supply for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select a value between 0 and the maximum rated output current for the supply for Side B.

5. Press ENTER to accept and exit.

SETTING THE MAXIMUM LIMIT FOR OUTPUT POWER

PROCESS → LIMITS → POWER

This function lets you set a maximum limit for output power. The default (and maximum allowable value) is the maximum rated output for the supply. Accuracy is +0.3% of full rated output power for the supply.

To set the user power limit:

1. Press PROCESS → LIMITS → POWER.

2. Rotate the MODIFY knob to select a value between 0 and the maximum rated output power for side A.

3. Press ENTER.

4. Rotate the Modify knob to select a value between 0 and the maximum rated output power for side B.

5. Press ENTER to accept and exit.

Setting Arc Handling

PROCESS → ARC

Use the ARC menu to implement arc-handling during your normal process cycle or during both your process cycle and your target conditioning cycle (TCC). Selections in the ARC menu let you establish arc-handling parameters for normal process runs: target type, hard arc count limit, and voltage trip level. The target type selection,

predefined (metal/non-metal) or custom, determines arc shutdown time, the length of time the supply's output is off after an arc has occurred. If custom arc handling has been selected, the user can also select an arc detect time, the length of time an arc persists before the arc shutdown time is implemented. In addition, the PROCESS menu lets you view arc density statistics.

Enabling the TCC algorithm places setpoint and arc handling under microprocessor control, letting you achieve fast, automated target conditioning. Before enabling the TCC algorithm, ensure that you have first entered a setpoint and set values for the PROCESS menu parameters.

Note: Units with a 10 kW inverter and a 208 V input configuration have a minimum arc shutdown time of 50 μs.

SETTING THE VOLTAGE ARC TRIP LEVEL

PROCESS → ARC → LEVEL

This function lets you set the voltage arc trip level, i.e. the output voltage level at which the unit determines an arc is occurring for both process mode and the TCC algorithm. If the voltage level stays below the specified trip level for the amount of time you set (in the DETECT function), the Pinnacle supply reacts by shutting down.

To set the arc trip level:

1. Press PROCESS → ARC → LEVEL.

2. Rotate the MODIFY knob to select an arc trip level for side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select an arc trip level for side B.

5. Press ENTER to accept and exit.

SETTING THE ARC COUNT LIMIT

PROCESS → ARC → COUNT

This function provides a count of hard arcs and of micro arcs that have occurred while the DC output has been on (density).

The hard arc counter counts one arc every time output is shut off due to an arc condition. The micro arc counter counts one arc every time an arc is extinguished. Both counters return to 0 when the output is cycled off and then back on.

To set the hard arc count limit:

1. Press PROCESS → ARC → COUNT.

2. Rotate the MODIFY knob to select a hard arc count limit for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select a hard arc count limit for Side B.

5. Press ENTER to accept and exit.

VIEWING THE ARC DENSITY

PROCESS → ARC → DENSITY

The hard arc counter counts one arc every time the output is shut off due to an arc condition. (See "Selecting Custom Arc Shutdown and Detect Times" on page 4-36.) The micro arc counter counts one arc every time an arc is extinguished. Both counters return to 0 when the output is cycled off and then back on.

To view the arc density of your process:

1. Press PROCESS → ARC → DENSITY.

   ‣ SECOND and RUN options appear.

2. To view arcs per second, press SECOND.

3. To view arcs per run, press RUN.

4. This display is not zeroed until you turn the output on again.

5. Press the MODIFY knob to exit.

SELECTING THE ARC HANDLING TIMES

PROCESS → ARC → TIMES

This function lets you indicate the type of arc handling in your process. You can select "pre-defined" or "custom" settings. The "pre-defined" setting is useful in situations where the arcing characteristics of a process are unknown, and hence it is difficult to set "custom" arc times. If you are an advanced user, you can select "custom" settings. "Pre-defined has two types of settings based on the type of target you have: metal or non-metal. Selecting metal or non-metal initiates pre-programmed arc detect times and arc shutdown times for the normal process cycle (PC) and for the target conditioning cycle (TCC) if TCC is enabled. (see "Passive Display Panel" on page 4-12 for more information about enabling TCC.) The following table shows those values:

Note: The target type determines the values for arc detect delay time and arc shutdown time.

Note: 10 kW and 20 kW Pinnacle units with a 208 VAC input configuration have a minimum arc shutdown time of 50 μs.

Table 4-11. Target Type Settings

Target Type	PC Detect Time (µs)	PC Shutdown Time (µs)	TCC Detect Time (µs)	TCC Shutdown Time (µs)
Metal	0	30 480 (slow arc)	20 320 (slow arc)	30 480 (slow arc)
Non-Metal	0	500 8000 (slow arc)	20 320 (slow arc)	500 8000 (slow arc)
Custom	Set by user; 10 values to choose from	Set by user; 10 values to choose from	20	20

> *Note:* If your unit has been configured with the slow arc feature, the "Shutdown" and "Detect" times for your unit (listed in the proceeding table) will be the larger value.

Selecting "custom" displays another menu to select a specific arc detect delay time and arc shutdown time (see the following section).

To select the pre-defined type of arc handling:

1. Press PROCESS → ARC → TIMES → PREDEFINED.

2. Use the MODIFY knob to select "Metal" or "Non-Metal" for Side A.

3. Press ENTER.

4. Use the MODIFY knob to select "Metal" or "Non-Metal" for Side B.

5. Press ENTER to accept and exit.

SELECTING CUSTOM ARC SHUTDOWN AND DETECT TIMES

PROCESS → ARC → TIMES → CUSTOM

Use this option to select a custom (user defined) arc shutdown time and an arc detect time. Shutdown is the amount of time the Pinnacle supply's output shuts off after an arc is detected. (The voltage level for detection is determined by the trip level function.) Detect time is the amount of time that an arc must last to be considered a long arc. A detect time of 0 µs to 2 µs is standard.

To select a custom arc shutdown time:

1. Press PROCESS → ARC → TIMES → CUSTOM → SHUTDOWN.

2. Use the MODIFY knob to select a time in micro-seconds: 10, 20, 30, 40, 50, 100, 200, 500, 1,000, or 2,500 for Side A.

   Note: If your unit is configured with the slow arc feature, the following custom arc shutdown time settings will be available to you: 160, 320, 480, 640, 800, 1600, 3200, 8000, 16000, and 40000 µs.

3. Press ENTER.

4. Use the MODIFY knob to select a time in micro-seconds: 10, 20, 30, 40, 50, 100, 200, 500, 1,000, or 2,500 for Side B.

   Note: If your unit is configured with the slow arc feature, the following custom arc shutdown time settings will be available to you: 160, 320, 480, 640, 800, 1600, 3200, 8000, 16000, and 40000 µs.

5. Press ENTER to accept and exit.

To select a custom arc detect delay time:

1. Press PROCESS → ARC → TIMES → CUSTOM → DETECT.

2. Use the MODIFY knob to select a time in micro-seconds: 0, 1, 2, 5, 10, 20, 50, 100, 200, or 500 for Side A.

   Note: If your unit is configured with the slow arc feature, the following custom arc detect delay time settings will be available to you: 0, 16, 32, 80, 160, 320, 800, 1600, 3200 and 8000 µs.

3. Press ENTER.

4. Use the MODIFY knob to select a time in micro-seconds: 0, 1, 2, 5, 10, 20, 50, 100, 200, or 500 for Side B.

   Note: If your unit is configured with the slow arc feature, the following custom arc detect delay time settings will be available to you: 0, 16, 32, 80, 160, 320, 800, 1600, 3200 and 8000 µs.

5. Press ENTER to accept and exit.

ENABLING ARC HANDLING

PROCESS → ARC → ENABLE

This function enables or disables the arc handling functions of the Pinnacle unit.

⚠ **WARNING:**

In most configurations, default at power up is arc handling enabled. If

To disable the arc handling:

1. Press PROCESS → ARC → ENABLE.

2. Rotate the MODIFY knob to select Yes or No for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select Yes or No for Side B.

5. Press ENTER to accept and exit.

Note: If your unit is configured to default to arc handling enabled, and you disable arc handing, cycling power to the unit resets arc handling mode to enabled.

Setting Control Parameters

PROCESS → CONTROL

Use this menu option to set up Pinnacle parameters that directly control the output of your process. The menu options are:

• RECIPE

• RAMP

• JOULES

• TCC

• SETPT

Setting Recipes

Use the RECIPE menu to implement a ramping recipe. This function lets you program the Pinnacle unit to ramp up in incremental steps (1 to 8 steps are possible). For each step, you must set a ramp time, a setpoint, and a run timer. Ramp time is the amount of time (in seconds) that the Pinnacle unit takes to ramp up to the setpoint for the specified step. Run timer is the amount of time (in seconds) for which the Pinnacle unit runs at setpoint for the specified step.

To enable this function, set the number of steps to 1, 2, 3, 4, 5, 6, 7, or 8. To disable this function, set the number of steps to 0.

To set the number of recipe steps:

1. Press PROCESS → CONTROL → RECIPE.

2. Select Side A or Side B by pressing the soft key below Side_A or Side_B.

3. Rotate the MODIFY knob to select a value from 1 through 8.

4. Press ENTER; the display progresses through a series of screens in which you enter ramp time, setpoint, and run timer for each step.

To set the ramp time, setpoint, and run timer value for each step:

1. After you have entered a value from 1 through 8 at the # OF STEPS screen (see steps 1 through 2 above), you should be looking at a screen that requests a RAMP TIMER value.

2. Rotate the MODIFY knob to select a value between 0.05 s to 600 s (in 0.01 s increments).

3. Press ENTER; the display progresses to a screen requesting a SETPOINT value.

4. Use the REGULATION key to toggle between power, current and voltage. Use the MODIFY knob to select a value between 0 and the full rated output of the supply.

5. Press ENTER; the display progresses to a screen requesting a RUN TIMER value.

6. Rotate the MODIFY knob to select a value between 0.00 s to 600 s (in 0.01 s increments).

   Note: If you turn the MODIFY knob quickly, the counts per click setting takes effect.

7. Press ENTER; if you have indicated that your recipe contains more than one step, the display returns to the RAMP TIMER screen so that you can enter recipe values for the next step.

8. Repeat Steps 2 through 7 as needed.

Note: If you assign 0 run time for the final recipe step, the unit will switch to continuous output when it reaches setpoint for this step. In this situation, to turn off output, you must send an off command (using the OFF button or the appropriate User port signal or Host (serial) port command) or you must have already programmed a joules setpoint.

Note: The setpoint source must be set to internal to run a recipe. See "Setting the Program Source" on page 4-27 for more information.

Setting the Ramp

PROCESS → CONTROL → RAMP

Use this option to ramp the output to a process setpoint.

This option allows you to enable the feature, set a ramp start setpoint percentage, and set a ramp time. The ramp time is set in 10 ms increments. The minimum ramp time is 0.05 s; the maximum ramp time is 600.00 s.

Note: If your unit has 100 ms ramp feature enabled, the range is 0.5 s to 6000.0 s.

Ramping is not allowed when TCC mode is enabled and vice versa. The out-of-setpoint timer is disabled while output is ramping.

The following equation is used to determine if the ramp is achievable by the processor:

- (setpoint - start_setpoint / ramp steps (in 10ms increments)) = delta_setpoint

The start_setpoint is equal to:

- (truncation)((setpoint * ramp_start_setpoint_percentage) / 100)

Note: Because this calculation does not allow a fractional portion, the ramp will be more accurate with a greater separation between start and end setpoints.

In order to allow the ramp the following must be true:

- (delta_setpoint * 65535) > 100

If the ramp is not achievable by the processor, error messages will flash on the display. However, output *will turn on* and the output will step directly to the requested setpoint.

Note: In current regulation mode two decimal places are implied (that is, 1000 = 10.00 A).

To enable ramp mode:

1. Press PROCESS → CONTROL → RAMP → ENABLE.

2. Rotate the MODIFY knob to select Yes or No to enable or disable ramp mode for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select Yes or No to enable or disable ramp mode for Side B.

5. Press ENTER to accept and exit.

To select the ramp starting point (a percentage of the setpoint):

1. Press PROCESS → CONTROL → RAMP → START_PT.

2. Rotate the MODIFY knob to select a percent for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select a percent for Side B.

5. Press ENTER to accept and exit.

To select the ramp time:

1. Press PROCESS → CONTROL → RAMP → TIME.

2. Rotate the MODIFY knob to select a time for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select a time for Side B.

5. Press ENTER to accept and exit.

Note: Under "Host" control mode, with ramp enabled, one can generate multiple ramps between setpoints by sending new setpoints while the output is on.

Setting Joule Mode

PROCESS → CONTROL → JOULES

This option lets you use joule mode, a method of automatically delivering a specified number of joules to the target. Choose THRESHOLD to specify a watt level to begin calculation, thereby enhancing the accuracy of the calculation by disabling the calculation during ignition. Choose ENABLE to enable or disable joule mode. Choose SETPT to program the number of joules you want to be delivered.

Note: The Joule energy calculation begins after (n) ms—regardless of the output power level. The time value, (n) ms, is set in the configuration and can not be changed. If the output power level meets the joule energy threshold prior to the time expiration, the joule energy calculation will begin.

To set the threshold at which to engage joule mode:

1. Press PROCESS → CONTROL → JOULES → THRESHOLD.

2. Rotate the MODIFY knob to specify a watt level (ranging between 10 W to 1/8 maximum output of supply) at which to begin calculation for Side A. When this level is exceeded, the joule calculation will begin.

3. Press ENTER.

4. Rotate the MODIFY knob to specify a watt level (ranging between 10 W to 1/8 maximum output of supply) at which to begin calculation for Side B. When this level is exceeded, the joule calculation will begin.

5. Press ENTER to accept and exit.

To enable joule mode:

1. Press PROCESS → CONTROL → JOULES → ENABLE.

2. Rotate the MODIFY knob to select Yes or No to enable or disable joule mode for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select Yes or No to enable or disable joule mode for Side B.

5. Press ENTER to accept and exit.

To program the number of joules you want to be delivered (joule setpoint):

1. Press PROCESS → CONTROL → JOULES → SETPT.

2. Press the soft key for Side A.

3. Rotate the MODIFY knob select a value between 0 and 9,999,999 joules (in 1 joule increments) for side A.

   ‣ If you are rotating the MODIFY knob slowly, press the appropriate soft key to indicate how quickly you want the display to increment the value (x1000, x100, x10 or x1).

      Note: If you turn the MODIFY knob quickly, the counts per click setting takes effect.

4. Press ENTER to accept the setting and exit.

5. Press the soft key for Side B.

6. Rotate the MODIFY knob select a value between 0 and 9,999,999 joules (in 1.0 joule increments) for side B.

   ‣ If you are rotating the MODIFY knob slowly, press the appropriate soft key to indicate how quickly you want the display to increment the value (x1000, x100, x10 or x1).

      Note: If you turn the MODIFY knob quickly, the counts per click setting takes effect.

7. Press ENTER to accept the setting and exit.

USING THE TARGET CONDITIONING CYCLE (TCC)

PROCESS → CONTROL → TCC

The TCC menu lets you enable the TCC (Target Conditioning Cycle) algorithm and set the TCC "idle" timer. Enabling the TCC algorithm places setpoint and arc handling under microprocessor control, letting you achieve fast, automated target conditioning. Before enabling the TCC algorithm, ensure that you have first entered a setpoint and set values for the arc handling parameters.

When TCC algorithm is enabled and the unit receives an on command, the microprocessor sets the arc detect time to 20 µs (320 µs for units configured with the slow arc feature) and initiates a series of trials (or "steps") to reach your desired setpoint ("the final setpoint"). To begin, the microprocessor sets an initial setpoint equal to 50% of the final setpoint. After 10 ms, the microprocessor checks the output level and sets a new interim setpoint equal to 125% of the output level. The microprocessor continues to check the output level and to set a new interim setpoint (always 125% of the output level) every 10 ms until the output level is equal to 80% of the final setpoint. When 80% of the final setpoint is reached, the interim setpoint is set equal to the final setpoint, the TCC algorithm ends, and arc handling is returned to the parameters you set up previously.

Enabling Target Conditioning Cycle (TCC)

PROCESS → CONTROL → TCC

This function enables or disables the TCC algorithm.

To enable TCC mode:

1. Press PROCESS → CONTROL → TCC → ENABLE.

2. Rotate the MODIFY knob to select Yes or No to enable or disable joule mode for Side A.

3. Press the ENTER soft key.

4. Rotate the MODIFY knob to select Yes or No to enable or disable joule mode for Side B.

5. Press ENTER to accept and exit.

Setting the Target Conditioning Cycle (TCC) TIMER

PROCESS → CONTROL → TCC

When TCC is enabled, the TCC algorithm executes automatically the first time the output is turned on. The TCC timer feature lets you set an acceptable idle time for subsequent runs. If the output is off for less than the idle time, the TCC algorithm does not re-initiate upon the next on command. If the output is off for longer than the idle time, the TCC algorithm executes with the next on command.

Note: If the timer is set to 0 and the TCC algorithm has been enabled, the unit will initiate the TCC algorithm every time output is turned on.

To enable the TCC timer:

1. Press PROCESS → CONTROL → TCC → TIMER.

2. Rotate the MODIFY knob to select the timer value for Side A.

3. Press ENTER.

4. Rotate the MODIFY knob to select the timer value for Side B.

5. Press ENTER to accept and exit.

SETTING THE SETPOINT

PROCESS → CONTROL → SETPT

To set the setpoint:

1. Press PROCESS → CONTROL → SETPT.

   ‣ SIDE_B and SIDE_A options appear.

2. Press the soft key for the side that you want to set.

‣ The fol_____en appears:

Side ——

Setpoint Source

Rea___

```
0000V  00.    00000W    A:iSETPT=xxxxxW
[E J L S V  T C]              RUN: 00:00:00
```

Status Feature   Warning Field   Clock I D
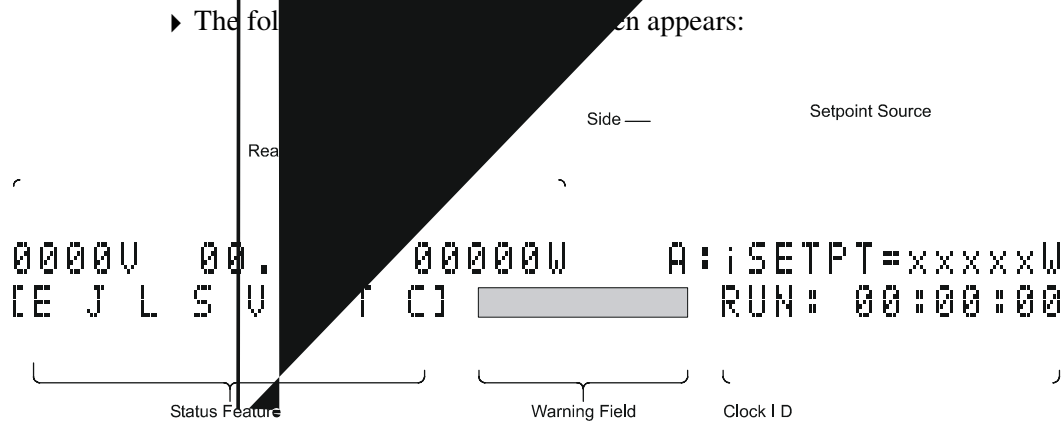
1410

The following information appears in the top line of the display (left to right):

‣ Voltage readback

‣ Current readback (in amps)

‣ Power readback (in watts)

‣ Side: A or B

‣ Setpoint Source: i = internal, e = external

‣ Setpoint

‣ Regulation Mode

The following information appears in the bottom line of the display (left to right):

‣ Status Features: a combination of the following letters appears in the status features area of the display, depending on which is enabled. If the feature is disabled, the display is blank.

  • E = side enabled
  • J = Joule mode enabled
  • L = Target life enabled
  • S = Setpoint timer enabled
  • V = Process voltage enabled
  • H = Hard arc counting enabled
  • T = TCC enabled (or R = Ramping enabled)
  • C = Custom arc handling (or P = Predefined arc handling enabled)

‣ Warning Field: flashes "EOTL" when end of target life or "ARCLIM" when the arc limit is reached.

  Note: ARCLIM is only active when the Hard Arc Counting feature is enabled.

‣ Clock ID: what the supply is doing

  • RMP = output is on and ramping
  • RUN = output is on and the clock shows the elapsed time

- • TCC = output is off and the TCC mode timer is active
- • OFF = output is off and the clock shows the last run time

3. Turn the MODIFY knob to select the setpoint.

4. Press the MODIFY knob to exit this menu, or press any soft key to go to the other side's setpoint menu.

Note: See "Regulation Switch" on page 4-16 and "On/Off Buttons & LEDs" on page 4-17 for more feature information.

STANDARD SERIAL (FLASH) PORT

Your Pinnacle supply contains a modified AE Bus serial (Host) communications interface, accessible through the standard serial port. This allows the Pinnacle unit to interface with a host computer. You can do everything from the host computer interfaced with the Pinnacle supply that you can do from the active front panel or the Pinnacle Remote Panel. For a complete list of available functions, see the list of AE Bus (Host) commands later in this chapter. To obtain a diskette containing sample software, as well as an executable version of the AE Bus Host software, please call AE Customer Support.

Note: The flash port is *not* available for serial communications on Pinnacle supplies equipped with either an AE Bus (standard or master/slaveable) or DeviceNet card installed.

Note: AE Bus commands are not available if your Pinnacle supply has a DeviceNet card.

Standard Serial Port Description

The standard serial port, or flash port, lets AE personnel program the internal flash function of the Pinnacle unit. If your Pinnacle power supply does not have an AE Bus, DeviceNet, or master/slaveable AE Bus Host card, it also lets you use the AE Bus protocol to communicate with the Pinnacle unit (see the following section "Transmission Parameters").

Located on the rear panel, the standard serial port is a shielded modular jack— illustrated in the following figure. (See also the rear panel illustration at the end of the "Installation" chapter.)

Pin 1
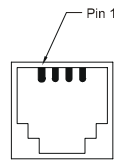
Connector is 2X actual size

1355

Figure 4-10. *Standard serial port*

The pin descriptions for this port are as follows.

Table 4-12. *Standard Serial Port Pin Descriptions*

Pin	Description
1	Do *not* connect
2	Power supply transmit
3	Power supply receive
4	Ground

For optimal performance, we recommend that you use only shielded modular cable between the Pinnacle unit's standard serial port and your host computer.

Transmission Parameters

The communications capability of the standard serial port is limited to the following parameters:

Note: These transmission parameters do *not* apply for units with AE Bus, DeviceNet, or master/slaveable AE Bus cards installed. For more information, see either the DeviceNet or AE Bus section in this chapter.

- RS-232 protocol

- Baud rate of 19.2 kbps

- Pinnacle unit address of 1

- Odd parity

- 1 start bit, 8 data bits, one stop bit

- Low-order bytes are transmitted before high-order bytes

Please note that the time-out period for the Pinnacle unit is factory set at 0.02 s (that is, no more than 20 ms can elapse between bytes or the unit will reset and begin looking for a new message packet). This can be changed using command **40**.

HOST/PINNACLE COMMUNICATIONS

The following sections describe AE Bus Host port-to-Pinnacle communications.

Communications Protocol

The AE Bus Host port/Pinnacle communications protocol uses pure binary data (nothing is coded into ASCII, for example) and is designed to facilitate direct communications between a host computer and the Pinnacle power supply.

The AE Bus message packet combines chunks of information in such a way that much information can be sent over communication lines at one time. Five types of information (fields) make up communications message packets (see Figure 4-5):

- Header (address and length of data field)
- Command (see list later in this chapter)
- Optional (supplements the header field)
- Data (optional field)
- Checksum (error checking)
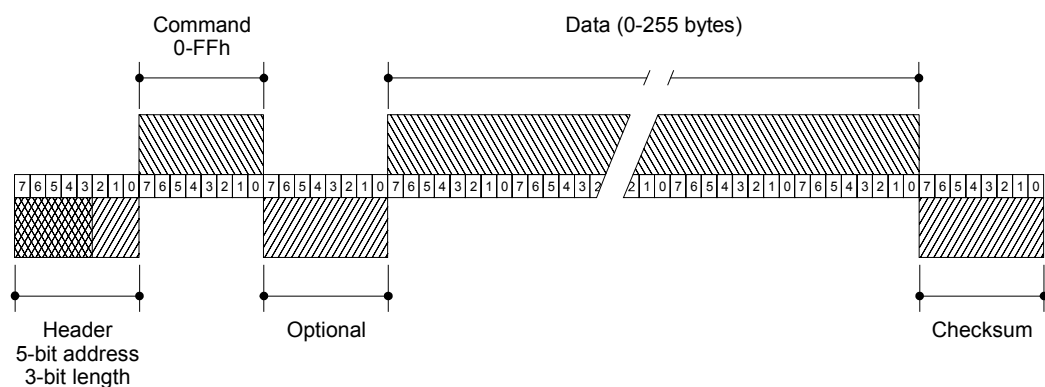
Figure 4-11. *Graphic representation of a message packet*

HEADER

This field contains two pieces of information: the first five bits contain the address, and the last three bits contain the length of the Data field. If the message packet originates with the host computer (master), the address specifies the packet's destination (to a Pinnacle unit, for example). If the packet is going to the host, the address specifies the packet's origin (from the Pinnacle unit). The address section of the Header field is five bits long, which allows a total of 32 distinct addresses. Address 0 (zero) is reserved for the network broadcast address; when this address is used in a host-originated packet, all units receive the packet (but will not respond).

The remaining three bits tell the receiving unit how long the Data field is so that the unit can determine when the entire message has been received.

Note: The value in these bits should refer only to the number of actual data bytes. Do not include the checksum byte when calculating the value for these bits.

The Header field (address and length) must be at the beginning of the message packet so that the receiving unit can compute the length of the packet after receiving the first byte.

COMMAND

This field contains a one-byte value: 00h to FFh (0 to 255). If the message packet originates with the host computer, this value specifies the purpose of the message packet. If the message originates with the Pinnacle unit, the value specifies the command to which it is responding. See

CHECKSUM

This one-byte field is the last one in the packet. The content depends on the value of each of the preceding fields. The transmitting unit determines this value by accumulating the XOR (exclusive-or) of all bytes of the packet up to, but not including, the checksum value. The receiving unit accumulates the XOR of all bytes of the packet, including the checksum. If the result is zero, the packet has likely been received intact.

Only after the checksum of a message packet is validated will the Pinnacle unit act on the message (which consists of the contents of the command, and if appropriate, the data fields).

Creating an Ideal Communications Transaction

The following figure is a simplified graphic showing the steps in an ideal communications transaction between a host computer and a Pinnacle unit.
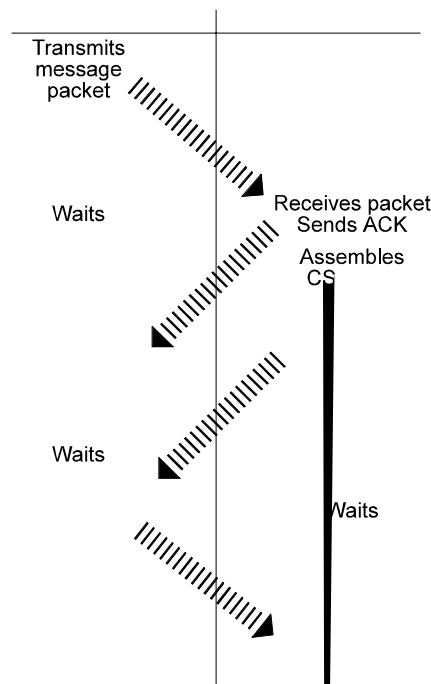
Figure 4-12. Communications transaction

First, the host computer sends a message packet to the Pinnacle unit. The packet contains one of the following:

- A command that requests data or status information

- A command and data that change a parameter setting

- An executable command

Once the Pinnacle unit receives the message packet, the Pinnacle unit verifies that the message is intended for it and not for another unit in the network. At this time, the Pinnacle unit also analyzes the checksum to verify that the message was received correctly.

If the address is incorrect (that is, if the message was not intended for the Pinnacle unit that received it), the Pinnacle unit does not respond to the host; the Pinnacle unit resets and resumes waiting for a message addressed to it. If the address is correct but the sum of the bytes in the packet (including the checksum) is not zero, the Pinnacle unit sends a negative acknowledgment (NAK) with a hex code of 15h to the host. If the address is correct and the message is intact, the Pinnacle unit sends an acknowledgment ACK with a hex code of 06h to the host.

If the Pinnacle unit receives a request for data or status information, it gathers and sends the requested information. Otherwise, it evaluates the incoming command and sends a message-packet that contains a 1-byte data value (CSR code) to the host (see "Host/Pinnacle Communications" on page 4-47). CSR code 0 is sent when the command has been accepted.

If the host receives a NAK from the Pinnacle unit, the host either re-transmits the packet or does whatever else it has been programmed to do in this situation. If the host receives an ACK, it waits for the requested data or status information or for the CSR code telling it whether or not the new parameter was accepted. If the host receives no response within a reasonable period, it takes whatever action it has been programmed to take.

Meanwhile, the Pinnacle unit has prepared a message packet with the requested information or appropriate CSR code, which it then transmits to the host. The host determines by means of the checksum if the message is complete. If the host detects an error in the transmission (by using the Checksum), it can request the packet be sent again by transmitting a NAK.

If the Pinnacle unit receives an ACK, it returns to the normal waiting state. If the Pinnacle unit receives a NAK, it re-transmits the message packet. The Pinnacle unit continues to re-transmit in response to NAK transmissions until the host stops the cycle. If the Pinnacle unit receives no response, it assumes an ACK and returns to the waiting state.

Understanding Command Status Response (CSR) Codes

When the Pinnacle unit sends a Command Status Response (CSR) code in response to a command, interpret the CSR (a one-byte response) code in the following way:

Table 4-13. *Command Status Response (CSR) Codes*

Code	Meaning
0	Command accepted
	The following CSR codes are returned when a command is not accepted and provide some indication of why.
1	Control mode is incorrect
2	Output is on
3	Output is off
4	Data is out of range
5	Invalid parameter
6	Program source is incorrect
7	Active fault(s) exist
8	Ramping is active
9	Data byte count is incorrect
10	User port has priority
11	Bus is not ready
12	This feature is not available on your unit
13	A front panel is active
14	Regulation mode is invalid
15	Ramp invalid (reset ramp start setpoint parameter to valid setting)
16	Target life has been consumed
19	Recipe active
20	Unit is disabled
21	Joule setpoint has not been reached
22	A process voltage fault has occurred
23	Inverter low fault active
24	A bus fault has occurred

Table 4-13. *Command Status Response (CSR) Codes (Continued)4040*

27	Off timer active
28	Setpoint exceeds user limit
30	TCC is active
31	The User port reset is active (you must de-assert the reset line on the User port)
32	The contactor is open (you must clear all active faults)
37	Ramp/Recipe inactive
38	Ramp/Recipe hold active
39	Ramp/Recipe hold inactive
40	The User port standby line is active de-assert
99	Command not accepted (there is no such command)

13

Figure 4-13. *Communications transaction example*

Host/Pinnacle Software Commands

To operate the power supply from a host computer, you must first set the control mode to host (command **14**).

Commands **1** through **127** change the value of a parameter or direct the power supply to perform a specific function.

Note: The master/slave functions listed in this section apply only to Pinnacle supplies with a master/slave Host card installed. Additionally, dual output Pinnacle units can *not* be configured for master/slave operation.

Table 4-14. *Host Port Commands (not available with DeviceNet)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
0 **null**	Null command. No action taken.	0	CSR only
1 **DC off**	Sets DC output off; this request is always honored, regardless of which interface has control.	0	CSR only
2 **DC on**	Sets DC output on; host control must be selected (see command **14**). Read back this value with command **161**.	0	CSR only
3 **regulation method**	Sets the method of output regulation (power, current or voltage). Send 1 data byte (8-bit value): • 6 = Power • 7 = Voltage • 8 = Current Read back this value with command **154**.	1	CSR only
4 **joule setpoint**	Specifies the number of joules to be delivered. Send a 4-byte (32-bit value); the value must be between 0 and 9,999,999. Read back this value with command **173**.	4	CSR only
5 **joule mode enable**	Enables or disables joule mode. Send 1 data byte (8-bit value): • 0 = Disable • Non-zero value = Enable Read back this value with command **153**.	1	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
6 **setpoint**	Specifies the output setpoint level for whichever method of regulation mode has been selected. Send 2 data bytes (16-bit value); an output power value should imply 3 decimal places, an output current value should imply 2 decimal places, and an output voltage value should imply 0 decimal places. For example, for a 6 kW standard Z supply send a value between 0 and 6000 (6.000 kW, decimal is implied), or 0 and 1500 (15.00 A, decimal is implied), or 0 and 800 (maximum output voltage). *Note:* Please refer to the "Specifications" chapter of this manual for your unit's capabilities. *Note:* If the ramp feature is enabled (commands **15** and **16**), sending this command while the output is on will force the unit to ramp from the existing setpoint to the new requested setpoint over the time specified in command **16**. Thus by use of this command and commands **15** and **16**, one can generate an output waveform during a process. Read back this value with command **164**.	2	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes

8
 	
arc shutdown detect times
	Specifies the amount of time that constitutes an arc and the amount of time the power supply shuts down after an arc. Send 2 data bytes.
	
	• First byte = Arc delay time index:
	
	  ▸ 0 = 0 µs
	  ▸ 1 = 1 µs
	  ▸ 2 = 2 µs
	  ▸ 3 = 5 µs
	  ▸ 4 = 10 µs
	  ▸ 5 = 20 µs
	  ▸ 6 = 50 µs
	  ▸ 7 = 100 µs
	  ▸ 8 = 200 µs
	  ▸ 9 = 500 µs
	• Second byte = Arc shutdown time index:
	  ▸ 0 = 10 µs
	  ▸ 1 = 20 µs
	  ▸ 2 = 30 µs
	  ▸ 3 = 40 µs
	  ▸ 4 = 50 µs
	  ▸ 5 = 100 µs
	  ▸ 6 = 200 µs
	  ▸ 7 = 500 µs
	  ▸ 8 = 1000 µs
	  ▸ 9 = 2500 µs
	
	Note: 10 kW and 20 kW Pinnacle units with a 208 VAC input configurations have a minimum arc shutdown time of 50 µs.
	
	Read back these values with command **170**.
		2	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
9 **hard arc count limit**	Sets the number of hard arcs required for the power supply to provide an arc indication. (If the limit is reached during a process cycle, then after output shuts off, the ARC LED lights and, if applicable, a pulse is sent to the User port *ARC.D* output signal.) Send 4 data bytes (a 32-bit value) indicating the number of arcs; the value must be at least 0 but no greater than the maximum for your unit. *Note:* A value of "0" disables the hard arc count limit feature so that the ARC LED does not light and no signal is sent to the User port. Read back this value with command **178**.	4	CSR only
10 **voltage arc trip level**	Specifies the voltage level at which the unit indicates an arc is occurring. Send 2 data bytes (16-bit value). Read back this value with command **171**.	2	CSR only
11 **active target**	Specifies which target will be active. Send 1 data byte (8-bit value); the value must be at least 1 but no greater than 8. *Note:* The User port has priority for target selection. Thus to select targets from the active front panel or from the Pinnacle Remote Panel (that is, when the Pinnacle unit is in local or host control mode), you must set the target to 1 at the User port. Leaving the target bits open or leaving the User port pins unconnected causes the target selection at the User port to default to 1. Read back this value with command **156**.	1	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
12 **target life**	Sets the life (in kilowatt-hours) of the target you specify. Send 1 data byte (8-bit value) plus 4 data bytes (32-bit value), arranged as follows: • First byte = Target number • Second/third/fourth/fifth bytes = Target life (in kilowatt-hours) *Note:* Two decimal places are implied (that is, to get 1 kW, send a value of 100). Read back this value with command **157**.	5	CSR only
13 **target enable**	Enables or disables the target life counter. Send 1 data byte (8-bit value): • 0 = Inactive • Non-zero value = Target life is active Read back this value with command **163**.	1	CSR only
14 **control mode**	Chooses the mode of control for the Pinnacle supply. *Note:* This request is always honored, if output is off, regardless of which interface has control. Send 1 data byte: • 2 = Serial (Host) port • 4 = User port • 6 = An active control panel. Read back this value with command **155**.	1	CSR only
15 **ramp enable**	Enables or disables the ramp feature. Send 1 data byte (8-bit value): • 0 = Disable • Non-zero = Enable Read back this value with command **163**.	1	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
16 **ramp time**	Sets the ramp time from 50 ms to 600.00 s (in 10 ms increments). Send a 2-byte value between 5 and 60,000. Two decimal places are implied (that is, to set 1.0 s, send a value of 100). Read back this value with command **158**.	2	CSR only
17 **program source**	Tells the Pinnacle supply whether the source of information for regulation mode and setpoints is internal or external (the source can be set independently for each of the three control modes). Send 3 data bytes: • First byte = Program source—if the serial (Host) port is active • Second byte = Program source—if a control panel is the active interface • Third byte = Program source—if the User port is active For each mode, send an 8-bit value as follows: • 0 = Program source is internal • Non-zero value = Program source is external (that is, an analog value from the User port) Read back these values with command **163**.	3	CSR only
18 **side enable**	Enables or disables one power supply in a two-power-supply unit. *Note:* If a supply is disabled, it cannot be turned on. Requires 1 byte: • 0 = Disable • Non-zero value = Enable Read back this value with command **163**.	1	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
19 **recipe steps**	Specifies the number of recipe steps in your recipe. Send 1 data byte (8-bit value); the value must be at least 0 but no greater than 8. A value of 0 disables the recipe feature. *Note:* For each recipe step, you must also set the regulation mode, setpoint, ramping time, and run time (commands **20**, **21**, **22**, and **23**). Read back this value with command **180**.	1	CSR only

20
 	
recipe regulation mode
	Specifies the regulation mode for a recipe step.
	
	Send two data bytes as follows:
	
	• First byte = Recipe step (must be a value greater than 0 but no greater than 8)
	• Second byte = Regulation mode:
	  ‣ 6 = Power
	  ‣ 7 = Voltage
	  ‣ 8 = Current
	
	Read back these values with command **182**.
		2	CSR only

21 **recipe ramp time**	Specifies the length of ramping time for a recipe step (that is, how long the unit will take to reach the setpoint you have defined for the selected recipe step). Send three data bytes arranged as follows: • First byte = Recipe step (must be a value greater than 0 but no greater than 8) • Second and third bytes = Value between 5 and 60,000 (or between 0.05s and 600 s); two decimal places implied. Read back these values with command **181**.	3	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
22 **recipe setpoint**	Specifies the setpoint for a recipe step. Send three data bytes arranged as follows: • First byte = Recipe step (must be a value greater than 0 but no greater than 8) • Second and third bytes = Value between 0 and the full rated output of the supply, for the regulation mode set with command **20** *Note:* See the "Specifications" chapter for your unit's capabilities and command **6** for the format of the value. Read back these values with command **182**.	3	CSR only
23 **recipe run time**	Specifies the length of time the unit will run at setpoint for a recipe step. Send 3 data bytes arranged as follows: • First byte = Recipe step (value must be greater than 0 but no greater than 8) • Second and third bytes = Value between 0 and 60,000 (or between 0 and 600 s); two decimal places implied *Note:* If you assign 0 run time for the final recipe step, the unit will switch to continuous output when it reaches setpoint for this step. In this situation, to turn off output, you must send an off command (using the OFF button or the appropriate User port signal or serial port command) or you must have already enabled joule mode and programmed a joule setpoint. Read back these values with command **183**.	3	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
24 **calculate logic crc**	Tells the Pinnacle supply to calculate its logic CRC. *Note:* During the approximately 2 seconds it takes to calculate the CRC, the Pinnacle unit will not respond to any other commands. Read this value back with command **230**.	0	CSR only
25 **calculate front panel crc**	Tells the Pinnacle supply to calculate the front panel software CRC. *Note:* During the approximately 2 seconds it takes to calculate the CRC, the Pinnacle unit will not respond to any other commands. Read this value back with command **230**.	0	CSR only
26 **joule threshold**	Specifies the output power level that needs to be met before the joule output energy calculation begins. To set the threshold (in watts), send 2 bytes (16-bit value) between 10 W and maximum unit power divided by 8. *Note:* The Joule energy calculation begins after (n) ms, regardless of the output power level. The time value, (n) ms, is set in the configuration and cannot be changed. If the output power level meets the joule energy threshold prior to the time expiration, the joule energy calculation will begin. Read back this value with command **136**.	2	0

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
30 **pre-defined arc handling type**	Specifies the type of target (metal or non-metal) for the pre-defined arc-handling mode: PC (normal process cycle) and, if enabled, TCC (target conditioning cycle). Send 1 data byte (8-bit value): • 0 = Metal • Non-zero = Non-metal The target type determines the values for arc detect time and arc shutdown time during both cycles (PC and, if enabled, TCC). The following table shows those values.	1	CSR only

Target Type	PC Detect Time (μs)	PC Shutdown Time (μs)	TCC Detect Time (μs)	TCC Shutdown Time (μs)
Metal	0	50	20	30
Non-metal	0	500	20	500

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
	Note: 10 kW and 20 kW Pinnacle units with a 208 VAC input configurations have a minimum arc shutdown time of 50 μs. Read back this value with command **174**.		
31 **out-of-setpoint timer**	Enables or disables an out-of-setpoint timer and specifies how long you want the power supply to tolerate an out-of-setpoint condition before shutting off output. • To enable the timer, send a value (2 bytes) between 1 and 600.0 s • To disable the timer, send a value of 0 Read back this value with command **187**.	2	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
32 **ramp start point (percentage of setpoint)**	Sets the ramp start point as a percentage of setpoint when output is turned on. The range is 0 to 95%. Send 1 byte with a value of 0 to 95. Read back this value with command **152**.	1	CSR only
37 **global on/off**	Enables or disables global on/off. If global on/off is enabled, sending an on or off command to either side of the supply will turn both sides on or off. Send 1 data byte: • 0 = Disable • Non-zero = Enable Read back this value with command **137**.	1	CSR
40 **serial (Host) port time-out value**	Specifies the amount of time the Pinnacle supply waits between bytes from the host. Send 2 data bytes (16-bit value). The value represents increments of 10 ms; it must be at least 2 but no greater than 500 (20 ms to 5 s) Two decimal places are implied (enter 500 for 5.00). Read back this value with command **140**.	2	CSR only
44 **panel text line 1**	This feature allows you write up to 40 characters of text to line one (top line) of an active control panel.	0 to 40	CSR only
45 **panel text line 2**	This feature allows you to write up to 40 characters of text to line two (bottom line) of an active control panel.	0 to 40	CSR only
46 **clear panel text**	Erases text displayed with commands **45** and **46** and refreshes the display.	0	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet)* *(Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
47 **process voltage limit on/off**	Enables or disables a voltage lower limit value for the process (8-bit value): • 0 = Disable • Non-zero value = Enable Read back this value with command **163**.	1	CSR only
48 **process voltage lower limit**	Sets a minimum process voltage. With this limit in place, the Pinnacle unit waits for the output voltage to first exceed the limit. Once that happens, output will remain on until you turn off the output or until the voltage falls below the established limit. If the voltage falls below the limit, output will turn off and error message **E010** or **E013** will appear on the display. With this command, send 2 data bytes (16-bit value). Read back this value with command **177**.	2	CSR only
You may set values for all three user output limits (commands **49**, **50**, and **51**); however, the Pinnacle unit responds to the first limit value that impacts output.		
49 **user power limit**	Sets a maximum limit for output power in kilowatts. Accuracy is +0.3% of the full rated output power for the supply. Send 2 data bytes (16-bit value); value must be between 0 and the maximum rated output power for the supply. Assume 3 decimals (10000 = 10.000 kW). Read back this value with command **141**.	2	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
50 **user voltage limit**	Sets a maximum limit for output voltage. Accuracy is +0.3% of the full rated output voltage for the supply. Send 2 data bytes (16-bit value); value must be between 0 and the maximum rated output voltage for the supply. Read back this value with command **142**.	2	CSR only
51 **user current limit**	Sets a maximum limit for output current. Accuracy is +0.3% of the full rated output current for the supply. Send 2 data bytes (16-bit value); value must be between 0 and the maximum rated output current for the supply. Assume 2 decimals (that is, 500 = 5.00 A). Read back this value with command **143**.	2	CSR only
52 **user strike voltage limit**	Sets a maximum strike voltage. Send 2 data bytes (16-bit value): • 0 = Low • 1 = Medium • 2 = High *Note:* High voltage output units (750–1500 VDC and 1500–3000 VDC) do *not* have strike voltage capability. Read back this value with command **144**.	2	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
61 **arc handling enable/ disable**	Enables or disables arc handling features. Send 1 data byte (8-bit value): • 0 = Disable • Non-zero = Enable *Note:* Cycling power to the unit resets arc handling mode to enabled. *Note:* Please see the warning on page 1-26. Read back this value with command **163**.	1	CSR only
77 **lock/unlock front panel**	Lets you set a code (5 ASCII digits) for locking the front panel; all zeros unlocks the panel; non-zero values lock the panel and set the locking code. Send 5 data bytes. *Note:* Cycling power to the unit sets the lock status to unlocked. Read back this value with command **193**.	5	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
79 **TCC enable**	Enables or disables TCC. Enabling the TCC places setpoint and arc handling under microprocessor control, letting you achieve fast, automated target conditioning. Before enabling TCC, ensure that you have first entered a setpoint and set a target type with command **30**. When TCC is enabled and the unit receives an on command, the microprocessor sets the arc detect time to 20 ms and initiates a series of trials ("the TCC algorithm") to reach your desired setpoint ("the final setpoint"). To begin, the microprocessor sets an initial setpoint equal to 50% of the final setpoint. After 100 ms, the microprocessor checks the output level and sets a new interim setpoint equal to 125% of the output level. The microprocessor continues to check the output level and to set a new interim setpoint (always 125% of the output level) every 100 ms until the output is equal to 80% of the final setpoint. When 80% of the final setpoint is reached, the interim setpoint is set equal to the final setpoint, and the TCC algorithm ends. Send 1 data byte (an 8-bit value): • 0 = Disable • Non-zero value = Enable Read back this value with command **163**.	1	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
80 **TCC timer**	Sets an acceptable idle time during TCC. When TCC is enabled, the TCC algorithm executes automatically the first time output is turned on. If the output, then, is turned off for less than the requested idle time, the TCC algorithm does not execute on the next output on cycle. If the output is off for longer than the requested idle time, the TCC algorithm executes on the next output on cycle. With this command, send 1 data byte (an 8-bit value): the value must be between 0 and 60 and represents seconds. Read back this value with command **185**.	0	CSR only
81 **front panel status refresh**	Resets the display on the front panel. Send the command only, no data.	0	CSR only
100 **recipe/ramp hold or resume**	While a recipe or ramp is executing, this command provides a means to stop or restart the recipe or ramp. • 0 = Resume • 1 = Hold	1	CSR only

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
101 **runtime recipe setpoint**	Send this command to specify a new setpoint level that is applied during the execution of a recipe or ramp. The setpoint takes effect immediately upon receipt by the power supply and applies to the step currently executing for which ever method of regulation is currently active. *Note:* See command **6** for the format of the 2 data byte setpoint value. If command **101** is issued during a ramp or the ramp portion of a recipe step, the power supply output will ramp to the new setpoint linearly in the ramp time remaining. The new setpoint will remain in place for the subsequent run following the ramp. If the recipe is not finished, the next ramp will begin at the new setpoint and ramp to the preprogrammed setpoint value for the recipe step. If command **101** is issued during the run portion of the ramp or recipe step, the power supply output will immediately step to the new setpoint. Command **101** can be issued as many times as necessary during the execution of a recipe with different setpoint values as needed. The originally programmed recipe values will not be affected by runtime changes of the setpoint value with command **101** and will be available for the next recipe execution. *Note:* The user should send command **164** to check the setpoint not command **182** after adjusting the setpoint with command **101**.	2	CSR only

Table 4-14. *Host Port Commands (not available with DeviceNet)* *(Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
119 **master reset**	Send this command to clear the fault indication when the Pinnacle supply has experienced a non-recoverable ("explicit clear") fault. This request is always honored, regardless of which interface has control.	0	0
126 **reset default settings**	Resets all user-defined values to their defaults and stores them in non-volatile memory. Send one data byte = 0 (8-bit value of 0).	1	CSR only
127 **write to scratch pad**	Lets you write up to 40 ASCII characters to a scratch pad memory (non-volatile). Retrieve this information with command **131**.	0 to 40	CSR only
Commands **128** through **255** request a value to be read from the Pinnacle unit.			
128 **request supply type**	Requests the power supply type; the returning packet contains 4 ASCII characters: "PNCL".	0	4
129 **request supply size**	Requests the output capacity of the power supply; the returning packet contains 6 characters indicating capacity in kilowatts. The data string implies 3 decimal places, that is 10000 = 10.000 kW. *Note:* For example, the string "10000" in ASCII would indicate a dual 10 kW supply.	0	6
130 **request maximum unit limits**	Requests maximum unit limits. Returns 6 bytes in response: • Bytes 1 and 2 = Power setpoint limit • Bytes 2 and 3 = Voltage setpoint limit • Bytes 4 and 5 = Current setpoint limit	0	6

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
131 **request scratch pad memory**	This command displays most recent entry (40 characters) to scratch pad memory.	0	40
136 **request joule threshold**	Requests the output power level that needs to be met before the joule output energy calculation begins. This level is set with command **26**.	0	2
137 **request global on/off status**	Requests the global on/off status set with command **37**. The returning packet contains 1 data byte: • 0 = Global on/off disabled • Non-zero = Global on/off enabled	0	1
140 **request host time-out value**	Requests the serial (Host) port time-out value that has been set in command **40**. The returning packet contains 2 data bytes (16-bit value) indicating the time in ms, that is a value of 2 indicates 20 ms.	0	2
141 **request user power limit**	Requests the output power limit you set with command **49**. Accuracy is +0.3% of the full rated output power for the supply. The returning packet contains 2 data bytes (16-bit value) indicating the limit in kilowatts. Assume 3 decimals, that is 10000 = 100.00 kW.	0	2
142 **request user voltage limit**	Requests the output voltage limit you set with command **50**. Accuracy is +0.3% of the full rated output voltage for the supply. The returning packet contains 2 data bytes (16-bit value) indicating the limit (in volts).	0	2

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Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
143 **request user current limit**	Requests the output current limit you set with command **51**. Accuracy is +0.3% of the full rated output current for the supply. The returning packet contains 2 data bytes (16-bit value) indicating the limit in amperes. Assume 2 decimals, that is 400 = 4.00 A.	0	2
144 **request user strike voltage limit**	Requests the strike voltage limit as set by command **52**. The returning packet contains 1 data byte (8-bit value): • 0 = Low • 1 = Medium • 2 = High *Note:* High voltage output units (750–1500 VDC and 1500–3000 VDC) do *not* have strike voltage capability.	0	1
150 **request recipe/ramp hold status**	Requests recipe/ramp status (that is, recipe on hold or recipe enabled) set with command **100**. • 0 = Recipe *not* on hold • 1 = Recipe on hold	0	1
152 **request ramp start setpoint percentage**	Requests the ramp start setpoint percentage set with command **32**. Returning packet contains 1 data byte (8-bit) between 0 and 95 (%).	0	1
153 **request joule mode status**	Requests joule mode status set with command **5**; the returning packet contains 1 byte: • 0 = Inactive • Non-zero value = Active	0	1

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
154 **request regulation mode**	Requests the output regulation mode (set by command **3**); the returning packet contains 1 data byte (8-bit value): • 6 = Power • 7 = Voltage • 8 = Current	0	1
155 **request control mode**	Requests control mode (set by command **14**). The returning packet contains 1 data byte (8-bit value): • 2 = Serial (Host) port • 3 = An active control panel • 4 = User port	0	1
156 **request active target number**	Requests an indication of the active target (set by command **11**); the returning packet contains 1 data byte indicating target 1, 2, 3, 4, 5, 6, 7, or 8.	0	1
157 **request target life**	Requests the amount of target life time (set by command **12**) remaining for the target you specify. Send 1 data byte indicating which target; the returning packet contains 4 data bytes (32-bit value) indicating the time remaining in kilowatt-hours. Two decimal places are implied. For example, a value of 100 indicates 1 kWh.	1	4
158 **request ramp time**	Requests ramp time set with command **16**. Returns a 2-byte value (16 bits) indicating a ramp time of 5 (50ms) to 60,000 (600.00 s).	0	2
159 **request ramp time remaining**	Requests how much ramp time is remaining. Returns a 2 byte value (16-bits), indicating how many 10ms intervals remain.	0	2

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
160 **request status**	Requests the status of the logic board. The information in the returning packet is used by AE Global Support.	0	6
161 **request output on status**	Requests the status of most recent output on sequence. The returning packet contains 1 data byte (8-bit value): 0 = Output on sequence OK 1 = Control mode invalid 2 = Unit is already on 4 = Limit exceeded 6 = Invalid setpoint source 7 = Active fault exists 8 = Ramp active 9 = Data byte count incorrect 10 = User port has priority 11 = Bus is not ready 15 = Invalid ramp parameters 16 = End of target life reached 20 = Unit not enabled (dual output units only) 17 = On/off race condition 28 = Setpoint is greater than the user limit 30 = TCC is active 31 = The User port reset is active (you must de-assert the reset line on the User port) 32 = The contactor is open (you must clear all active faults 40 = *Standby.d* is active 44 = The Pinnacle unit has not received a request to turn output on	0	1

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes

162
 	
request process status
	Requests a report on process status.
	
	1st status byte:
	
	  0 = Unassigned
	  1 = Ramp active
	  2 = Run active
	  3 = Output power (0 = off, 1 = on)
	  4 = Illegal regulation mode
	  5 = Cable interlock
	  6 = End-of-target-life event
	  7 = Setpoint status (0 = within tolerance,
	      1 = out-of-tolerance)
	
	2nd status byte:
	
	  0 = User port auxiliary interlock
	  1 = User port vacuum interlock
	  2 = User water interlock
	  3 = Control circuit fault
	  4 = Heat sink overtemperature event
	  5 = User interlock open
	  6 = User port reset active
	  7 = Main contactor interlock open
	
	3rd status byte:
	
	  0 = Non-maskable interrupt
	  1 = Unassigned
	  2 = Stuck push button
	  3 = Front panel communication fault
	  4 = Unit A inverter low
	  5 = Unit B inverter low
	  6 = Unassigned interrupt event
	  7 = PROFIBUS error
	
	4th status byte:
	
	  0 = Bus fault
	  1 = Process voltage low
	  2 = Unassigned
	  3 = Unassigned
	  4 = Out-of-setpoint timer expired
	  5 = Ground fault detected
	  6 and 7 = Unassigned
		0	4

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
163 **request config status**	Requests the system configuration status; the returning packet contains 2 data bytes. 1st status byte: 0 = Host program source (0 = internal, 1 = external) 1 = Local program source (0 = internal, 1 = external) 2 = Analog program source (0 = internal, 1 = external) 3 = Arc mode (0 = custom, 1 = pre-defined) 4 = Arc handling (0 = disabled, 1 = enabled) 5 = Unit enabled 6 = Program source (0 = internal, 1 = external) 7 = Target life status (0 = inactive, 1 = active) 2nd status byte: 0 = Front panel status (0 = present, 1 = not present) 1 = Front panel access (0 = unlocked, 1 = locked) 2 = Joule mode (0 = disabled, 1 = enabled) 3 = Contactor status (0 = open, 1 = closed) 4 = Process voltage limit (0 = disabled, 1 = enabled) 5 = Ramp mode (0 = disabled, 1 = enabled) 6 = TCC status (0 = disabled, 1 = enabled) 7 = Unassigned	0	2

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
164 **request setpoint/ regulation mode**	Requests the setpoint level (set by command **6**) by whichever method of output regulation has been selected (set by command **3**). The returning packet contains 3 data bytes: • First/second byte = Setpoint level (16-bit value) • Third data byte = Regulation mode: (8-bit value) ‣ 6 = Power ‣ 7 = Voltage ‣ 8 = Current *Note:* Please refer to command **3** for the format of the setpoint level value.	0	3
165 **request actual power**	Requests a snapshot of the output power level at that instant; the returning packet contains 2 data bytes (16-bit value) indicating power level in kilowatts. Three decimal places are implied. For example, a value of 6000 would indicate 6.000 kW. *Note:* Please refer to the "Specifications" chapter of this manual for your unit's capabilities.	0	2
166 **request actual voltage**	Requests a snapshot of the output voltage level at that instant; the returning packet contains 2 data bytes (16-bit value), indicating the voltage level. For example, a value of 800 would indicate 800 V (no implied decimal).	0	2
167 **request actual current**	Requests a snapshot of the output current level at that instant; the returning packet contains 2 data bytes (16-bit value). Two decimal places are implied. For example, a value of 1500 indicates 15.00 A.	0	2

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Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
168 **request actual power, voltage, current**	Requests a snapshot of the output power, voltage, and current at that instant. The returning packet contains 6 data bytes: • First/second byte = Power level • Third/fourth byte = Voltage level • Fifth/sixth byte = Current level *Note:* Refer to commands **165**, **166**, and **167** for the format of the reported output values.	0	6
169 **request setpoints: power, voltage, and current**	Requests the setpoint levels for power, voltage, and current. The returning packet contains 6 data bytes (three 16-bit values): • Bytes 1 and 2 = Power setpoint level • Bytes 3 and 4 = Voltage setpoint level • Bytes 5 and 6 = Current setpoint level *Note:* Refer to commands **165**, **166**, and **167** for the format of the reported setpoint values.	0	6
170 **request custom arc settings**	Requests the arc delay and shutdown indices set by command **8**. Returning packet contains 2 data bytes: • First byte = Arc detect time index (8-bit value) • Second byte = Arc shutdown time index (8-bit value)	0	2
171 **request voltage arc trip level**	Requests the voltage level at which the unit indicates an arc is occurring (set with command **10**). The returning packet contains 2 data bytes (16-bit value) indicating the trip level in voltage.	0	2

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
172 **request joules remaining**	Requests how many joules remain during a run; the returning packet contains 4 data bytes (32-bit value) indicating the number of joules.	0	4
173 **request joules setpoint**	Requests the joules setpoint set with command **4**; the returning packet contains 4 data bytes (32-bit value) indicating the setpoint level in joules.	0	4
174 **request target type**	Requests the target type you selected with command **30**. The returning packet contains 1 data byte (8-bit value): • 0 = Metal target • Non-zero value = Non-metal target	0	1
175 **request time output on**	Requests how much time has elapsed since output power was turned on. The returning packet contains 3 data bytes: • First byte = Number of hours • Second byte = Number of minutes • Third byte = Number of seconds	0	3
177 **request process voltage limit**	Requests the process voltage lower limit set with command **48**. The returning packet contains 2 data bytes (16-bit value) indicating the limit.	0	2
178 **request hard arc count limit**	Requests the hard arc count limit set with command **9**. The returning packet contains 4 data bytes (a 32-bit value) indicating the limit.	0	4

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
179 **request active recipe step, ramp/ run status, and ramp/run time remaining**	Requests the active recipe step number, the ramp/run status, and the ramp/run time remaining. The returning packet contains 4 data bytes (32-bit value) indicating the following: • First byte = Active recipe step number • Second byte = Ramp/run status ▸ (1 = ramp, 2 = run) • Third and fourth bytes = Ramp/run time remaining in seconds. Two decimal places are implied. For example, a value of 5 would indicate 0.05s or 50 ms.	0	4
180 **request recipe steps**	Requests the number of recipe steps that you have set with command **19**; the returning packet contains 1 data byte (8-bit value) indicating the number of steps. *Note:* A value of 0 sent with command **19** disables the ramping recipe feature.	0	1
181 **request recipe step ramp time**	Requests the amount of ramping time you have set for a specific ramping recipe step (set with command **21**). Send 1 data byte (8-bit value) indicating the recipe step. The returning packet contains 2 data bytes (16-bit value) indicating the time in seconds. Two decimal places are implied. For example, a value of 5 would indicate 0.05 s.	1	2

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes

182
 	
request recipe step setpoint and regulation mode
	Requests the setpoint level you have set for a specific ramping recipe step set with command **22**.
	
	Send 1 data byte (8-bit value) indicating the recipe step.
	
	The returning packet contains 3 data bytes:
	
	• First and second bytes = Value of setpoint in the mode indicated
	• Third byte = Regulation mode
	    • 6 = Power
	    • 7 = Voltage
	    • 8 = Current
		1	3

183 **request recipe step run time**	Requests the run time you have set for a specific recipe step set with command **23**. Send 1 data byte (8-bit value) indicating the recipe step. The returning packet contains 2 data bytes indicating the run time in seconds. Two decimal places are implied. For example, a value of 5 would indicate 0.05 s.	1	2
184 **request out-of-setpoint interval**	Requests the amount of time remaining on the out-of-setpoint timer before an error condition occurs; the returning packet contains 2 data bytes (16-bit value) indicating the interval value in seconds. One decimal place is implied. For example, a value of 999 would indicate an interval of 99.9 s.	0	2
185 **request TCC timer**	Requests the acceptable idle time set with command **80**. The returning packet contains 1 data byte (8-bit value) indicating the idle time in seconds.	0	1

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
187 **request out-of-setpoint timer**	Requests the out-of-setpoint timer value set with command **31**. The returning packet contains 2 data bytes (16-bit value) indicating the timer value in seconds. One decimal place is implied. For example, a value of 999 would indicate a timer value of 99.9 s.	0	2
188 **arc density per second**	Requests the arc density that occurred in the previous second. The returning packet contains 4 data bytes: • First/second byte = Micro arcs (16-bit value) • third/fourth bytes = Hard arcs (16-bit value)	0	4
189 **request micro arc density**	Requests how many micro arcs occurred in the previous run. The returning packet contains 4 data bytes (32-bit value) indicating the number of micro arcs.	0	4
190 **request hard arc density**	Requests how many hard arcs occurred in the previous run. The returning packet contains 4 data bytes (32-bit value) indicating the number of hard arcs.	0	4
194 **request high speed knob click**	Requests the number of high speed clicks per count of the MODIFY knob on an active control panel. The returning packet contains 1 data byte (8-bit value) indicates a count between 1 and 40.	0	1

Table 4-14. Host Port Commands (not available with DeviceNet) (Continued)

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes

195
 	
request personality card
	Requests the identity of the unit's personality cards.
	
	The returning packet contains 2 data bytes.
	
	• First byte = Identity of card in slot 1:
	
	  ▸ 0 = Card not present
	  ▸ 01 or 17 = Dual User port card
	  ▸ 03 or 25 = PROFIBUS Host card
	  ▸ 05 or 21 = Single User port card
	  ▸ 27 = Single User port card
	
	• Second byte = Identity of card in slot 2:
	
	  ▸ 0 = Card not present
	  ▸ 03 or 25 = PROFIBUS Host card
	  ▸ 04 = Host Protocol Translator card
	  ▸ 05 or 21 = Single User port card
	  ▸ 27 = Single User port card
	  ▸ 18 or 28 = AE Bus Host card
		0	2

197 **request flash configuration**	Requests the version level of the unit's flash memory; returning packet contains 32 data bytes.	0	32
198 **request s/w rev level—mainframe**	Requests the revision level of the mainframe software; the returning packet contains 12 ASCII characters.	0	12

Table 4-14. *Host Port Commands (not available with DeviceNet) (Continued)*

Command	Description	Number of Host Data Bytes	Number of Response Data Bytes
220 **request customer service statistics**	Allows AE Global Support to access unit statistics. Send 1 data byte (8-bit value): 0 = Total output in kilowatt-hours 1 = Total idle time 2 = Total run time 3 = Total unit on events 4 = Total output on events 5 = Total over-temperature events 6 = Total control circuit faults 7 = Total out-of-setpoint events 8 = Total bus fault events 9 = Total power fluctuation events 10 = Total process voltage low events 11 = Total unit A inverter low events 12 = Total unit B inverter low events 13 = Total user interlock open events 14 = Total cable interlock open events 15 = Total contactor interlock open events 18 = Total PROFIBUS fault events 19 = Total pre-defined interrupt events 20 = Total unassigned interrupt events 22 = Total DSP watchdog faults	1	4
230 **request logic, panel, CRC or DSP**	Requests the CRC of the logic, front panel or DSP. • To receive the logic CRC, first send command **24**, which calculates the value • To receive the front panel CRC, first send command **25** With command **230**, send one data byte: • 0 = Logic • 1 = Front panel • 2 = DSP	1	2

Host Port Command Sequence Examples

The following two examples illustrate how you may communicate with the Pinnacle unit using the AE Bus command protocol.

EXAMPLE 1: SETTING THE TIMEOUT VALUE

This example shows how to use command **40** to set the Host port timeout value to 4.32 seconds. The example assumes that the Pinnacle unit address is 16.

For command **40**, the upload packet sent from the PC host to the Pinnacle unit requires the following information:

- Address of Pinnacle unit
- Number of data bytes in the upload packet
- Data bytes
- Checksum

The first byte of the upload packet contains the unit address and the number of data bytes. The first five bits contain the address (16 = binary 10000). The last three bits contain the number of data bytes required for command **40**, which is two (2 = binary 010). The whole byte has a hex value of 82h (binary 10000010).

The second byte of the packet contains the command number.

The third and fourth bytes of the packet are the data bytes, which contain the value for the command. In this case, the value is in seconds, with two decimal places implied. Since you want a value of 4.32 seconds, the data bytes should contain a value of 432. Data bytes are sent least significant byte first, most significant byte last. The value of 432 has a hex value of 01B0h.

The upload packet from the PC host to the Pinnacle unit:

- Byte 1 = 82h – address and # of data bytes
- Byte 2 = 28h – command **40**
- Byte 3 = B0h – least significant
- Byte 4 = 01h – most significant
- Byte 5 = 1Bh – checksum

The Pinnacle unit responds to the request by sending a download packet that contains an acknowledgement, the address and number of data bytes, the command, a command status response (CSR) code, and a checksum.

The reply packet from the Pinnacle unit to the PC host:

- Byte 1 = 06h – (ACK)
- Byte 2 = 81h – address 16, and 1 data byte (binary 10000001)
- Byte 3 = B0h – command
- Byte 4 = 00h – CSR code
- Byte 5 = A9h – checksum

The PC host should then respond to the unit with an acknowledgement.

- Byte 1 = 06h – (ACK)

EXAMPLE 2: SETTING TARGET LIFE

This example shows how to use command **12** to set the target life in Target 1 to 7500.00 kWh. The example assumes that the Pinnacle unit address is 16.

For command **12**, the upload packet sent from the PC host to the Pinnacle unit requires the following information:

- Address of Pinnacle unit

- Number of data bytes in the upload packet

- Data bytes

- Checksum

The first byte of the upload packet contains the unit address and the number of data bytes. The first five bits contain the address (16 = binary 10000). The last three bits of byte #1 contain the number of data bytes required for command **12**, which is five (5 = binary 101). The whole byte has a hex value of 85h (binary 10000101).

The second byte of the packet contains the command number.

The third byte of the packet contains the first data byte = target number.

The fourth through seventh bytes of the packet are the last four data bytes and contain the value for the target life. In this case, the value is in kW hours, with two decimal places implied. Since you want a value of 7,500 kWh, the data bytes should contain a value of 750000. Data bytes are sent least significant byte first, most significant byte last. The value of 750000 has a hex value of B71B0h.

Packet sent to unit from PC host:

- Byte 1 = 85h – address and # of data bytes
- Byte 2 = 0Ch – command **12**
- Byte 3 = 01h – target # 1
- Byte 4 = B0h – least significant
- Byte 5 = 71h
- Byte 6 = 0Bh
- Byte 7 = 00h – most significant
- Byte 8 = 42h – checksum

Reply returned from unit:

- Byte 1 = 06h – (ACK)
- Byte 2 = 81h – address 16, and 1 data byte (binary 1000001)
- Byte 3 = 0Ch – command
- Byte 4 = 00h – CSR code
- Byte 5 = 8D – checksum

The PC host should then respond to the unit with an acknowledgement.

- Byte 1 = 06h – (ACK)

UNIT ILLUSTRATIONS
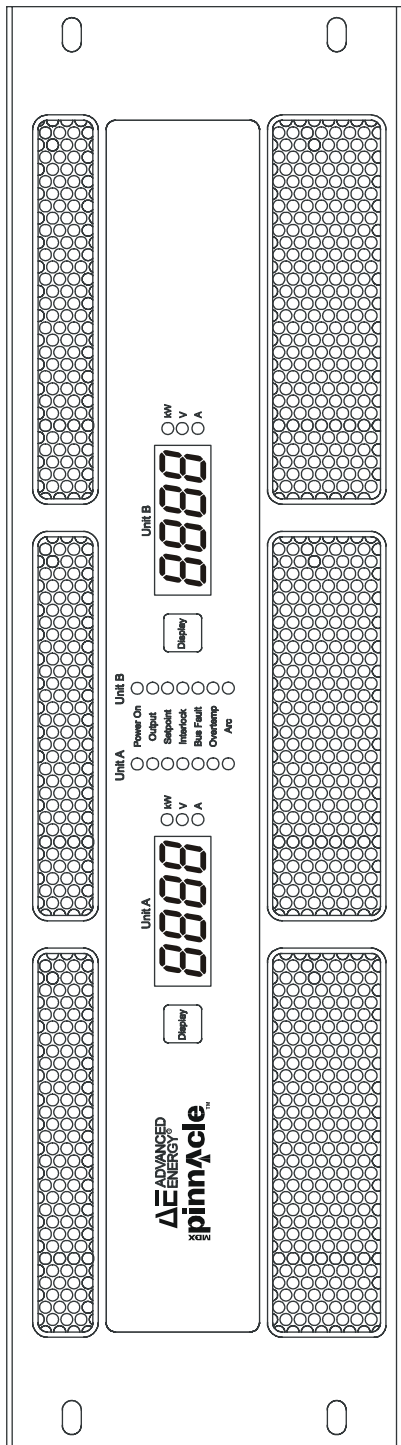
Figure 4-14. *Passive front panel (front view)*
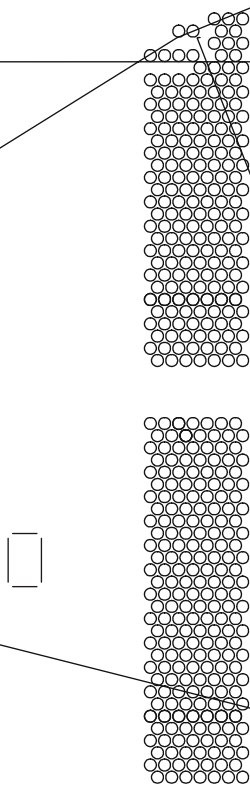
Figure 4-15. Active front panel (front view)

Modify

C   On   Off

On   Off   Arc

Figure 4-16. *Remote panel (front view)*
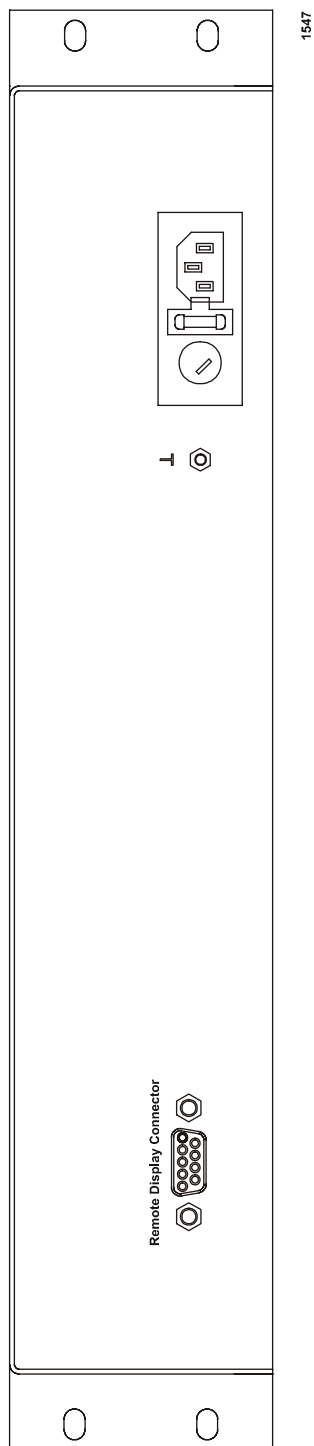
Figure 4-17. Remote panel (rear view)
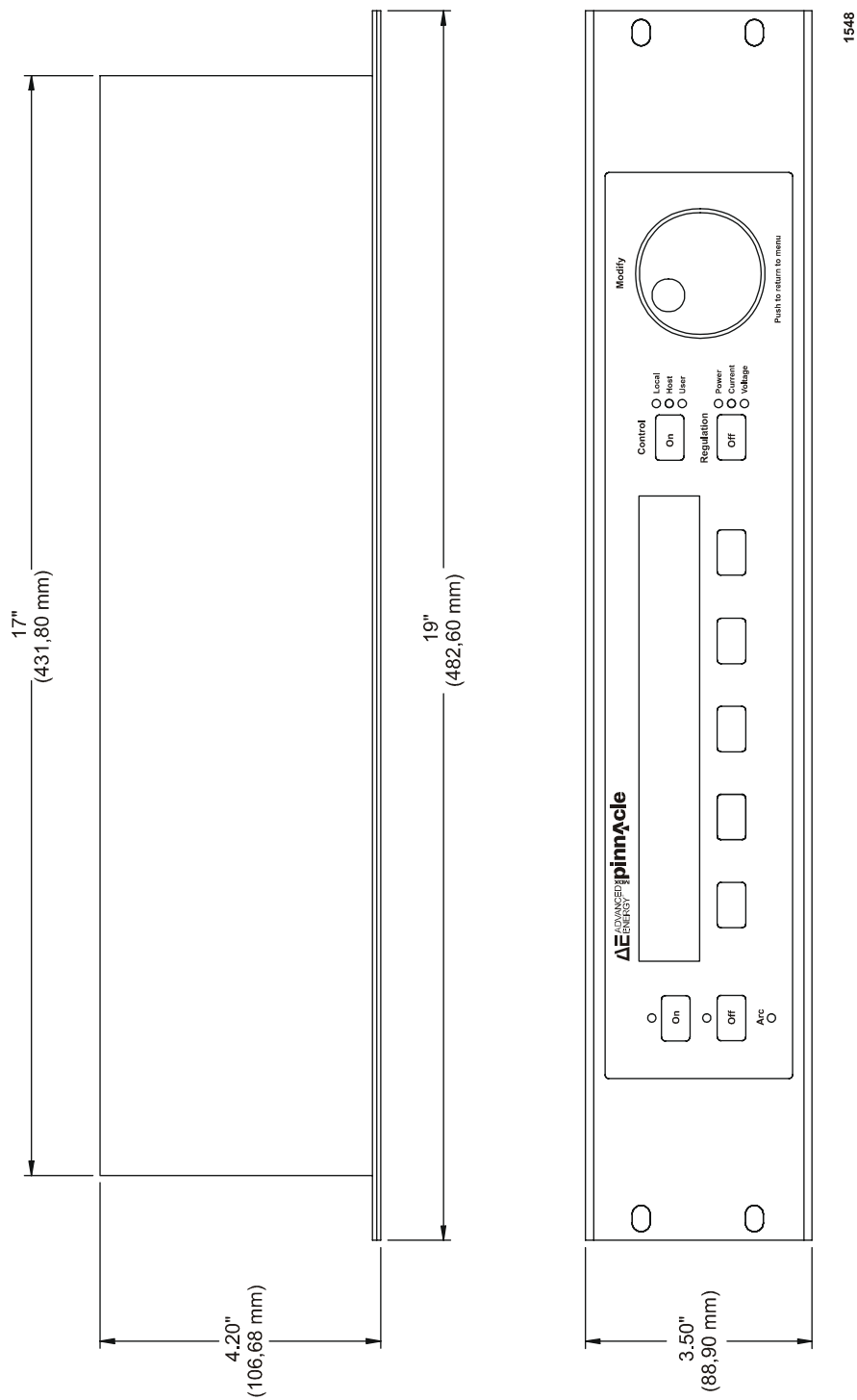
Figure 4-18. *Remote panel (dimensions)*

Installation

UNPACKING

Unpack and inspect your Pinnacle power supply carefully. Check for obvious physical damage. If no damage is apparent, proceed with the unit connections. If you do see signs of shipping damage, contact Advanced Energy Industries, Inc., and the carrier immediately. Save the shipping container for submitting necessary claims to the carrier.

MEETING SPACING REQUIREMENTS

See Figure 5-1 on page 5-2 for a graphical representation of the spacing requirements.

- The clearance between either side of the Pinnacle supply and the enclosure must be 76 mm (3 in).

- The clearance between the top of the Pinnacle supply and the top of the enclosure must be 25 mm (1 in).

- No clearance is required between power supplies.

- The clearance between the rear of the Pinnacle supply and the enclosure must be 102 mm (4 in), with adequate ventilation.
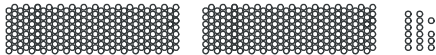
Figure 5-1. *Dimensional drawing*

COOLING REQUIREMENTS

For the Pinnacle supply to be sufficiently cooled, the cabinet must be set up to:

- Bring in coolant air of the correct temperature (40ºC maximum)
- Distribute coolant air to the power supplies
- Prevent air exhausted from the cabinet from circulating back and becoming input air
- Exhaust the hot air from the cabinet with minimal airflow restriction.

See Figure 5-2 on page 5-5 for more detail.

Cabinet Design

The following is a synopsis of the principles to follow when designing a cabinet containing a stack of Pinnacle power supplies.

Coolant air must be drawn easily into the cabinet; exhaust air must be able to pass unrestricted out of the cabinet. If some physical constraint restricts the flow of exhaust air out of the cabinet, we recommend that fans or blowers be mounted so that the hot air is removed from the cabinet as quickly as possible.

Each Pinnacle power supply dissipates up to 10% of its maximum power at full rated output. The minimum air flows in CFM (cubic feet per minute) required by individual Pinnacle supplies are shown in Table 5-1 on page 5-3. The static pressure (inches of water) of the empty cabinet should not exceed 0.1 inches of water at the CFM level obtained by adding together the minimum CFM values for all the power supplies that will be placed in the cabinet. For example, if three Pinnacle supplies are mounted in a cabinet, the minimum CFM requirement would be three times the CFM of cabinet air volume compared to an individual supply. Approximations of this figure, the total power dissipation, and the temperature difference between coolant air and exhaust air are shown as an example in Table 5-2 on page 5-4.

Table 5-1. Minimum CFM Required for a Pinnacle Supply

Pinnacle Supply	CFM Required
6 kW	100 CFM
6x6 kW	120 CFM
12 kW	120 CFM
10 kW	120 CFM
10x10 kW	200 CFM
10x6 kW	160 CFM
20 kW	200 CFM

Table 5-2. *Approximate Cooling Requirements for Three Pinnacle Units Mounted in a Cabinet*

Type of Pinnacle Supply	CFM for 3 Supplies	Total Power Dissipation	Dif. in Temp. Between Coolant & Exhaust Air
6 kW	300 CFM (100+100+100=300)	1800 W (600+600+600=1800)	20°C
6x6 kW	360 CFM (120+120+120=360)	3600 W (1200+1200+1200=3600)	20°C
12 kW	480 CFM (120+120+120=360)	3600 W (1200+1200+1200=3600)	20°C
10 kW	360 CFM (120+120+120=360)	3000 W (1000+1000+1000=3000)	20°C
10x10 kW	600 CFM (200+200+200=600)	6000 W (2000+2000+2000=6000)	20°C
10x6 kW	480 CFM (160+160+160=480)	4800 W (1600+1600+1600=4800)	20°C
20 kW	600 CFM (200+200+200=600)	6000 W (2000+2000+2000=6000)	20°C

Input Air Through Front Panel

4" (102 mm)
minimum clearance
between rear of rack
and rear of enclosure

Exhaust Air

1" (25 mm)
minimum clearance
between unit and
top of rack

0" (0 mm)
minimum clearance
between units

3" (76 mm)
minimum clearance from
enclosure to rack,
each side

1345
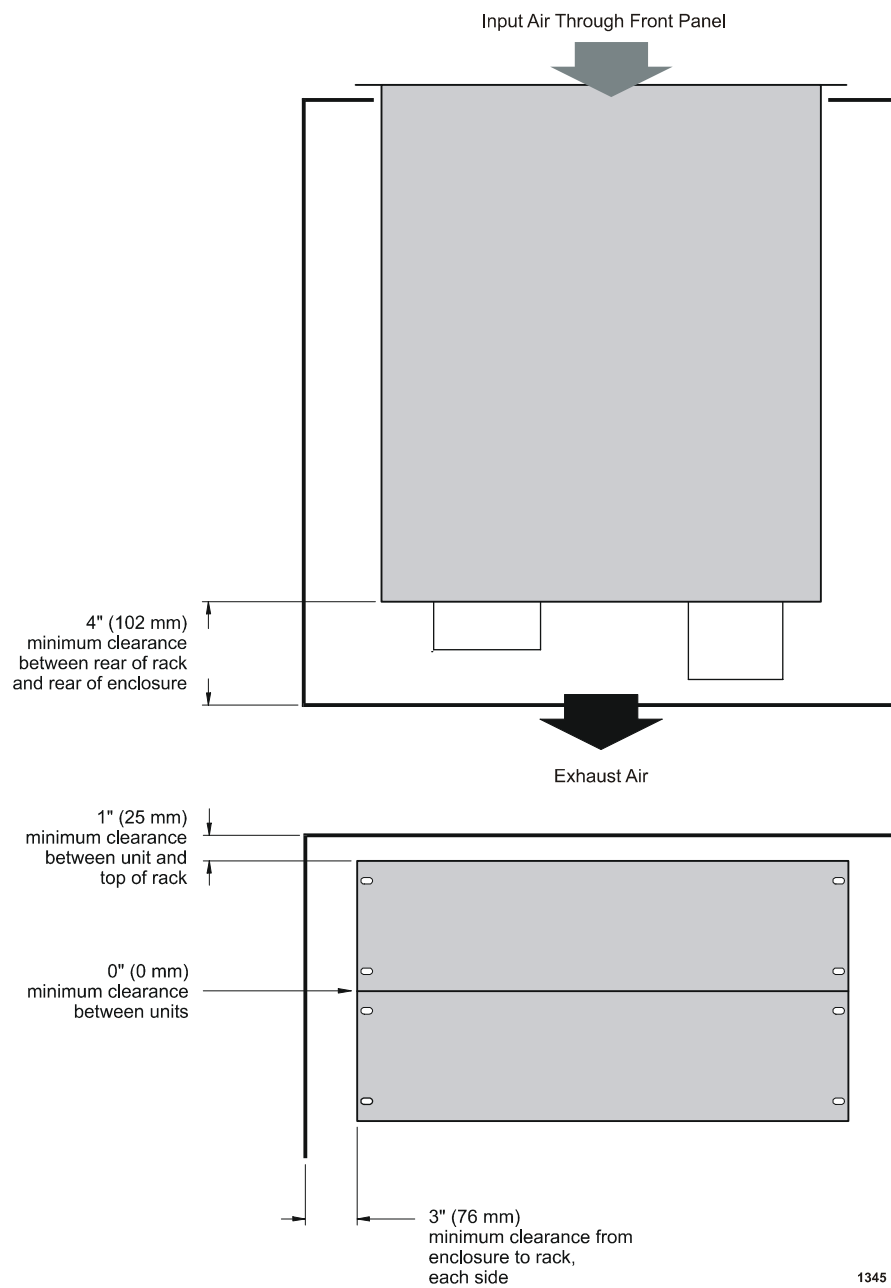
Figure 5-2. *Top, side, and inter-unit clearance for Pinnacle units stacked in a cabinet*

MAKING REAR PANEL CONNECTIONS

⚠️ **DANGER:**
> **RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.**

⚠️ **WARNING:**
> **Operating and maintenance personnel must have the correct training before setting up and maintaining high-energy electrical equipment. This equipment must be installed according to applicable requirements.**

⚠️ **CAUTION:**
> **Do not apply RF power directly to the output of the Pinnacle unit. Damage to the Pinnacle unit could result. If you are using both an RF power supply and a Pinnacle supply in the same system, include an RF filter in the system.**

Grounding

For your convenience, the rear panel of the Pinnacle supply features three equi-potential ground studs: two M5 studs and a 10-32 stud. These are indicated on the rear panel by a ground symbol. Connect one of these studs to protective earth ground.

⚠️ **WARNING:**
> **Before making any other connection, connect one of the equi-potential ground studs to earth ground.**

Note: For optimal performance, ground an equi-potential ground stud to the system ground.

Connecting a Pinnacle Remote Active Panel

Connections for an Advanced Energy Pinnacle Remote Active Panel are made through a 9-pin, male, subminiature-D connector labeled REMOTE ACTIVE PANEL on the rear panel. See "Pinnacle Active Front Panel" in chapter 4 for further information.

Note: To reduce EMI interference, we recommend using shielded cable to connect to the Remote Active Panel port.

Connecting a Remote Passive Panel

Connections for a remote passive front panel are made through the female, 15-pin, subminiature-D connector labeled REMOTE PASSIVE PANEL on the rear panel. The rear of the remote passive panel features a male, 15-pin, subminiature-D connector. Use the cable provided with the remote passive panel to connect the panel to your Pinnacle unit.

Connecting for User Port Control

Please reference the "I/O Communication and Control" chapter for instructions on connecting your analog/digital interface.

Note: To reduce EMI interference, we recommend using shielded cable to connect to the User port.

Connecting to the Standard Serial Port

This interface lets you use most parameters of the AE Bus communications protocol during serial communications with a host computer. Please reference the "I/O Communication and Control" chapter for details on making this connection.

Connecting for Serial (Host) Port Control

Please reference the "I/O Communication and Control" chapter for instructions on connecting your serial communications (Host) port.

Note: Any time you remove one Host card and replace it with another, you must restore all system defaults. Restoring defaults will reset User port limits and the front panel display; additionally, restoring defaults will ensure the Pinnacle unit recognizes the new Host card (or lack of Host card).

Note: To reduce EMI interference, we recommend using shielded cable to connect to the serial port.

Contactor Interlock

The CONTACTOR INTERLOCK port, located on the rear panel, is a 9-pin, male, subminiature-D connector (see Figure 5-3 on page 5-8). Before turning on output, ensure that the interlock loop is closed. To enable the Pinnacle supply's main contactor, short together pins 3 and 4 on the CONTACTOR INTERLOCK port (through a cheater plug, external switch, or relay). Pin 4 supplies the interlock system (string) with 18 V. It can source 60 mA. Pin 3 can sink 60 mA, and the voltage on pin 4 should not exceed 20 V. On the 400 V Pinnacle supply, pins 1 and 2 on this port are feedback connections from a set of (normally open) auxiliary connectors on the main contactor.
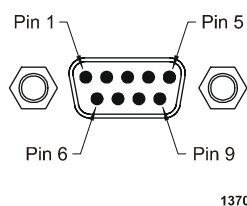
Figure 5-3. *CONTACTOR INTERLOCK connector*

Note: The mating connector, connector shell, and post screws are included in the hardware kit that accompanied your Pinnacle unit.

Connecting for DeviceNet™ Control

If you have a DeviceNet interface, please reference the DeviceNet section in chapter 4 of this manual for instructions on connecting it.

Note: To reduce EMI interference, we recommend using shielded cable to connect to the serial port.

Connecting Input Power

Your Pinnacle supply's input voltage is 208 VAC, 400 VAC, or 480 VAC, three phase, 50/60 Hz. All power supplies leave the factory with their input voltages identified on the rear panel and on an enclosed test checklist.

The AC line input connection is provided by means of a five terminal, DIN terminal block on the rear panel. Labels on the input terminal shield and below each terminal position on the rear panel show line (L3, L2, L1), neutral (N), and protective earth/ground connections (GND). Note that no neutral connection is required. However, if neutral is present, connect it to the N terminal.

⚠ **DANGER:**

This equipment must be wired using a fixed connection.

⚠ D

Note: To con... ...r supply, you need stranded wire of a gauge
consist... ...pplicable requirements.

To connect to ... **connector:**

1. Strip appr... ...ion from the en...

2. Separate t... ...m...
   wire.

3. Ensure that ...w and green wire...
   longer than...

4. Remove the ... the strain relief.

5. Slip the cabl... ...rough the cord grip.

6. Connect each wire to the proper input terminal block according to...
   Tighten the cable clamp on the line cord, and replace the cover.

Note: Use only a shielded input cable on the input power connector.

Connecting Output Power

⚠ **DANGER:**

RISK OF DEATH OR BODILY INJURY. Disconnect and Lockout/Tagout all sources of input power before disconnecting output cables. Disconnect all sources of input power before working on this unit or anything connected to it.

⚠ **DANGER:**

This unit must be installed so that the input and output connections are inaccessible to the user. Lethal voltages are potentially present once the input connections are complete. Be sure connectors are terminated and follow normal safety precautions when the system is operating.

⚠ **CAUTION:**

Improper connection to the output connector could hamper operation of the Pinnacle unit. If you are unsure how to connect your output cable between the Pinnacle unit and your chamber, please contact AE Customer Support.

⚠ **CAUTION:**

To comply with EMI/EMC standards, you must use a shielded output cable and connect the shield to the ground terminal on the Pinnacle

The standard output connector is either a female UHF-type connector or a three-terminal, multi-contact, pluggable connector. The cables for the output connection are not included with the Pinnacle supply. Use connecting wire consistent with your application and applicable requirements. For connecting instructions, read the following pages.

> ⚠ **WARNING:**
>
> **To meet SELV (Safe Extra Low Voltage) requirements, you must tie the shield of the UHF connector (positive) to the chamber ground or tie the positive terminal of the three-terminal output connector to chassis ground at the output connector. Do not allow either positive to exceed ±40 V with respect to ground.**

UHF CONNECTOR

> ⚠ **DANGER:**
>
> **RISK OF DEATH OR BODILY INJURY. All units with UHF connectors must be installed so that the output connections are inaccessible to the operator.**

The output connector for your Pinnacle supply may be a female UHF connector. A strain relief box is provided with the connector, but the mating connector and the output cable are not provided. With this connector, we recommend using RG 393U silver-plated, double-shielded cable with a Teflon® center insulator. We recommend an Amphenol 83-822 mating connector that accepts a 5 mm diameter wire.

1591
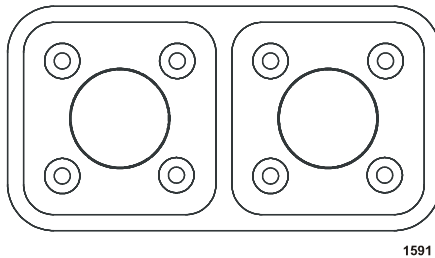
Figure 5-4. *Rear view of UHF output connector*
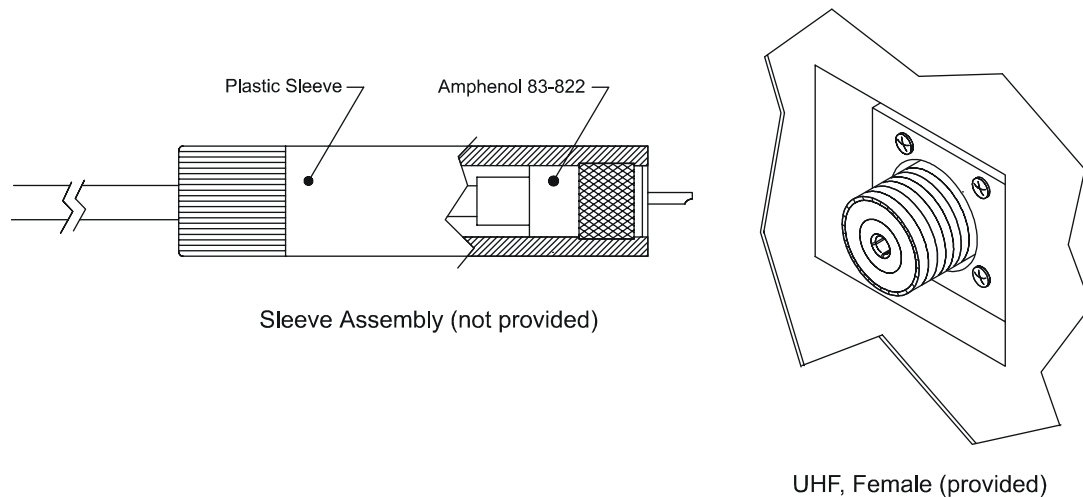
Figure 5-5. *UHF connector and sleeve assembly*

Military Specification Number

The military specification number for the Pinnacle unit's female, UHF output connector is SO-239. When working with this connector, use tools appropriate for military specification SO-239 and assemble connecting materials according to specifications.

UHF Connection With Interlock

The UHF connector provides interlock. The interlock is closed when the housing's back plate (with its three interlock pins) is properly attached. When you remove the back plate, the interlock is open and output from your Pinnacle supply is turned off.
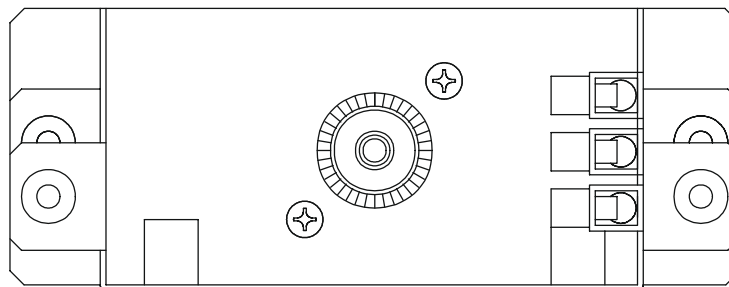
Figure 5-6. *Rear view of UHF connector housing with interlock (back plate removed)*

Grounding the UHF Output

The strain relief provides 14 mm to 16.5 mm grounding. When connecting the Pinnacle unit's output to the system, ensure that the cable shield (also the positive) connects with the chamber ground and that the negative wire (cable core) connects to the target.
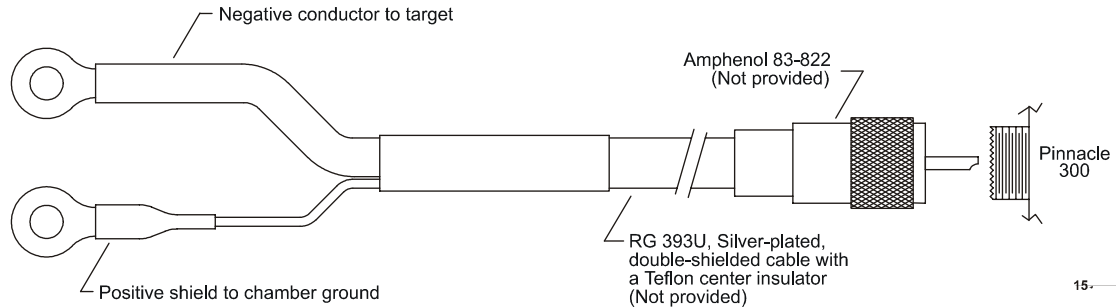
Figure 5-7. *Recommended mating connector and cable for UHF output*

NEGATIVE OUTPUT WITH THREE-TERMINAL, MULTI-CONTACT CONNECTOR

The most common output configuration for sputtering applications is negative output (negative voltage with respect to ground). To achieve negative output, connect the Pinnacle unit's negative terminal on the output connector to the chamber's cathode. Connect the positive terminal on the unit's output connector to the chamber's common or ground.

Use the ground terminal on the Pinnacle unit's output connector to terminate the output cable shield only. Neither the terminal nor the outer shield of the output cable should carry load current. Do not use the unit's ground terminal as a system ground. Do not connect a current-carrying conductor to the terminal, even if the conductor is a shield element of the cable.

To make this connection, strip approximately 1 cm of insulation from the end of the cable to expose the three wires. Feed one wire into each opening according to the labels on the output connector. Tighten the two small screws on each compression terminal.

OPTIMAL OUTPUT CONNECTION

We recommend using shielded output cable between the Pinnacle supply and your chamber and connecting that cable in the manner described here (see Figure on page 5-10 and Figure 5-11 on page 5-16). The shielded cable minimizes system noise from chamber arcs and takes full advantage of the Pinnacle unit's improved process rate. The following paragraphs describe recommended connections and cable types.
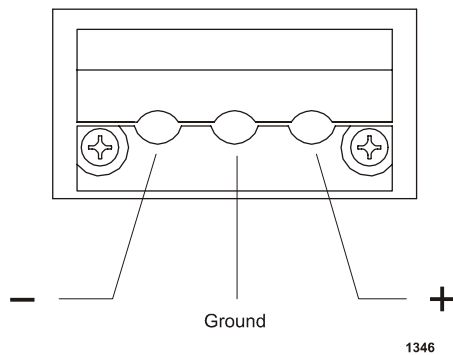
Figure 5-8. *Three-terminal, multi-contact, pluggable connector for 6 kW*
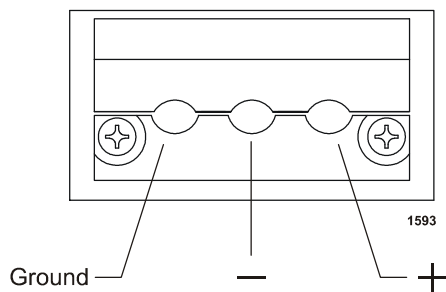
Figure 5-9. *Three-terminal, multi-contact, pluggable connector for 10 kW*

To Chamber Wall

Outer Shield Unterminated

To Chamber Anode

1594
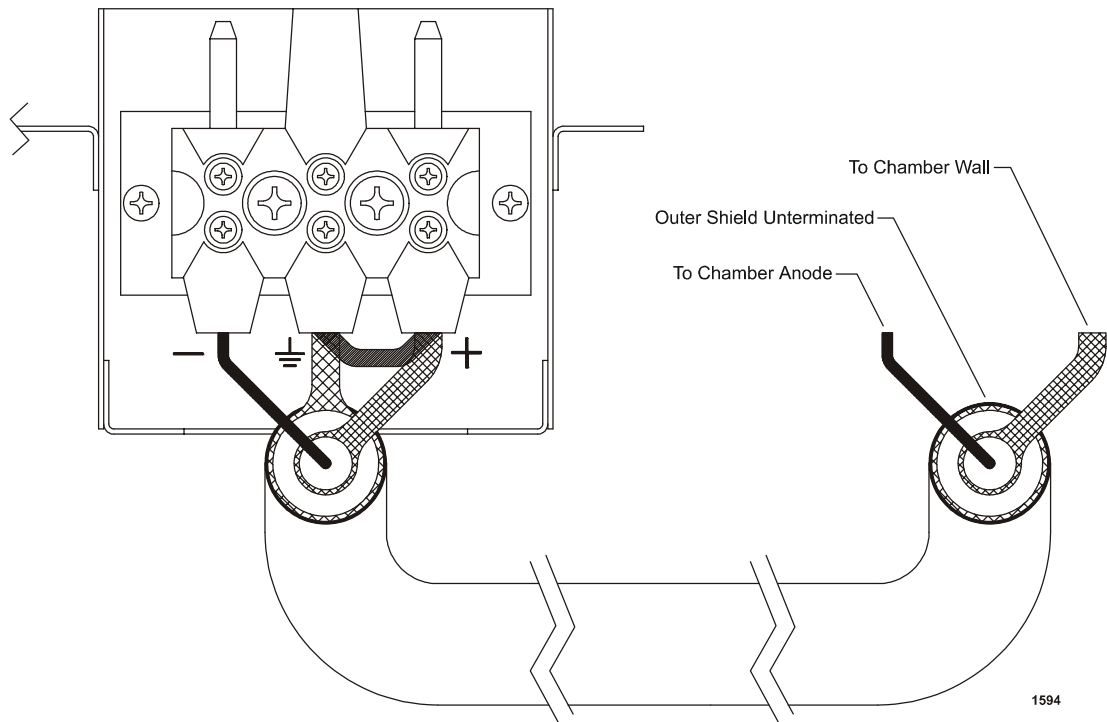
Figure 5-10. *Optimal output connection for 6 kW using triax cable*
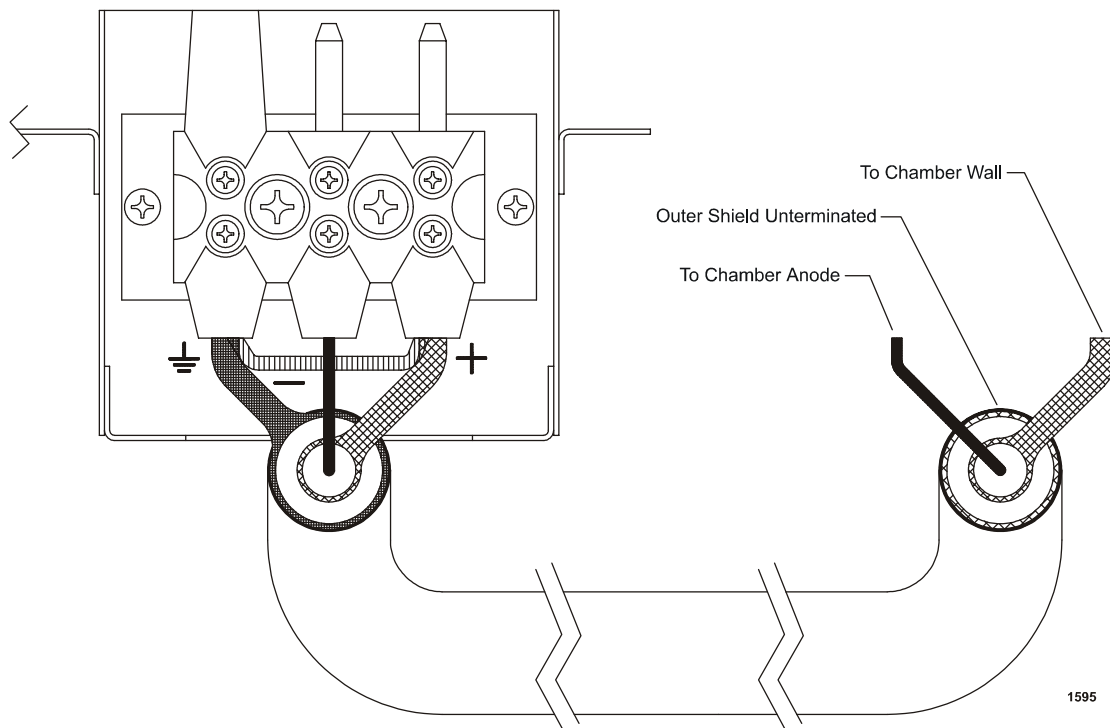
Figure 5-11. *Optimal output connection for 10 kW using triax cable*

The most effective output connection has the following qualities:

1. The outer shield should be terminated at one end only. (If the shield is terminated both at the Pinnacle unit and at the load, the outer shield could carry some of the load current, causing the cable to radiate noise.) Terminate the outer shield at the ground connection provided at the Pinnacle output connector only (leaving the shield unterminated at the load).

2. The current-carrying elements of the output cable should be in close proximity to each other to minimize magnetic noise fields. (Note that the conducting elements are those parts of the cable connected to the positive and negative terminals on the Pinnacle output connector.) Magnetic noise fields occur in a size proportional to the "loop area" between the conducting elements. If you minimize the loop area, you can minimize the magnetic noise.
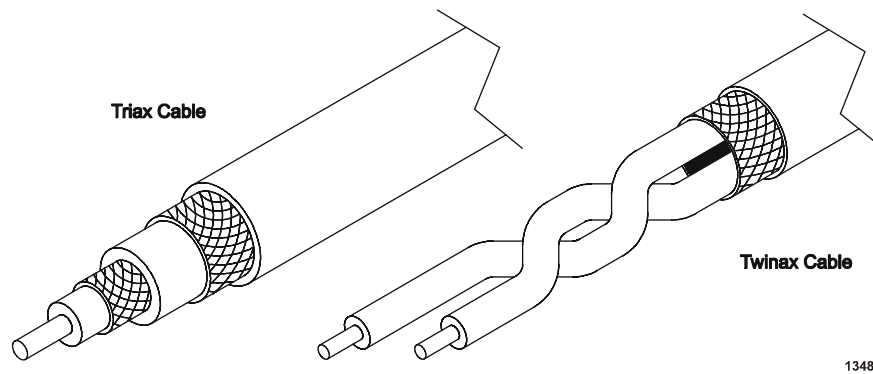
Figure 5-12. *Two styles of cables for optimal output connection*

Two styles of output cabling satisfy both of the described conditions: "triax" cabling and "twinax" cabling (see Figure 5-12 on page 5-17). Triax cable is much like coax cable, except that triax contains an additional shield that surrounds an inner shield and center conductor. Twinax cable consists of a twisted pair of wires that are surrounded by an outer shield.

Regardless of which style output cable you use, do not allow the outer shield to carry load current.

BACK PANEL ILLUSTRATION

1376
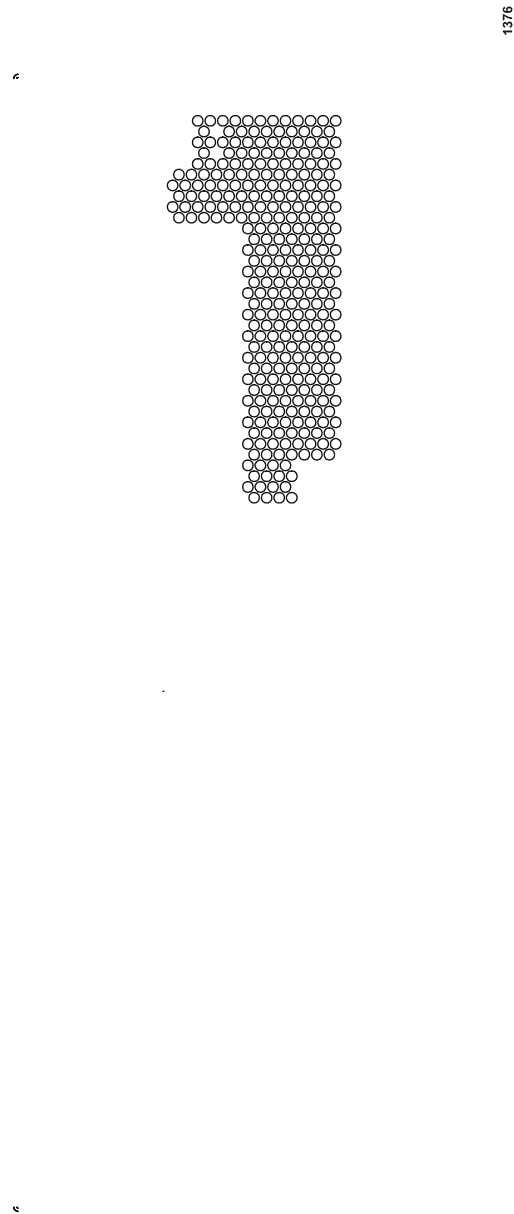
Figure 5-13. *Passive and active front panel (rear view)*

Operation

OPERATING OVERVIEW

The following list represents a general description of how to operate a Pinnacle unit. You will want to adapt this list to your Pinnacle configuration and your application, environment, and requirements.

Note: If an error code (that is, an "E xx" code) appears on the front panel or on the Pinnacle Remote Active Panel, refer to the "Troubleshooting" chapter for an explanation and troubleshooting suggestions.

1. Turn on the Pinnacle unit.

   ▸ Verify your unit's LEDs. If you are using a passive panel, verify that the POWER ON and INTERLOCK LEDs light. If the INTERLOCK LED does not light, an error code should appear (see the "Troubleshooting" chapter for more information).

   ▸ If you are using an active front panel or a Pinnacle Remote Panel, verify that the display screen displays two messages in sequence: "Advanced Energy, Fort Collins, Colorado" and then "Power Up Sequence, Please Wait." In addition, verify that an LED lights to show the control setting and another lights to show the regulation setting. Finally, verify that the OFF LED lights.

   Note: The unit defaults to the previously selected control and regulation settings. If the unit had been in LOCAL mode with a Pinnacle Remote Panel but the Remote Panel is removed, the unit will boot up in Host control mode. If there is no Host card, the unit will boot up in User control mode. An active DeviceNet card will act as a Host card, but if the DeviceNet card is not active the unit will boot up in User control mode.

   Note: If the display screen shows no message and/or if no control or regulation LEDs light, ensure that the unit is properly installed and is receiving AC input power.

2. Check non-lighted LEDs and the display panel. If you are using the passive panel, verify that the BUS FAULT and OVERTEMP LEDs are not lit. If either or both is lit, power down the Pinnacle unit, clear the fault, and return to Step 1. (Refer to the "Troubleshooting" chapter for error code explanations and troubleshooting suggestions.)

   ▸ If you are using an active front panel or the Pinnacle Remote Panel, verify that the "output display screen" information shows on the display screen (see the "Active Front Panel/Pinnacle Remote Panel" section of Chapter 4 for details). If the display screen shows an error code and message, note the error code number and refer to the "Troubleshooting" chapter.

3. Select a method of control: Host (serial) port, User port, or local (panel control).

4. Select a regulation mode: power, current, or voltage.

5. Enter a setpoint value.

6. If necessary, enable joule mode and select a setpoint in joules (available only through the serial port, the active front panel, or the Pinnacle Remote Panel).

7. If necessary, enable target life counters and select a target life for each applicable target (available only through the serial port, the active front panel, or the Pinnacle Remote Panel).

8. If necessary, enter appropriate arc-handling parameters for your normal process cycle and, if needed, for your target conditioning cycle (available only through the serial port, active front panel, or the Pinnacle Remote Panel).

   Note: If you enable the TCC algorithm, you cannot use ramping recipes.

9. If necessary, create a ramping recipe (available only through the serial port, active front panel, or Pinnacle Remote Panel).

   Note: You cannot use ramping recipes if you have enabled the TCC algorithm.

10. If necessary, set the out-of-setpoint timer to a value other than 0 (available only through the serial port, active front panel, or Pinnacle Remote Panel).

11. If necessary, set limits for output power, output voltage, output current, strike voltage, and/or process voltage (available only through the serial port, active front panel, or Pinnacle Remote Panel).

    Note: The strike limit controls the level of the strike/ignition voltage but also impacts the initial power overshoot experienced when requesting low setpoints. For example, with a strike voltage limit setting of "high," you may observe a significant overshoot when requesting a low power. If ignition is not difficult the user can select "medium" or "low" to reduce the effects of overshoot.

12. Verify all output power load conditions and connections, and when the system is ready, enable the output. The output information on the output display screen should equal your requested setpoint.

    ‣ Verify your unit's LEDs. If you are using a passive front panel, verify that the OUTPUT and SETPOINT LEDs light. If these LEDs do not light, see the "Troubleshooting" chapter for more information.

    ‣ If you are using an active front panel or the Pinnacle Remote Panel, verify that the ON LED lights. Also, verify that the display screen shows values for output information. If the display screen shows an error code and message, see the "Troubleshooting" chapter for error code explanations and troubleshooting suggestions.

UNDERSTANDING PINNACLE™ ARC HANDLING

Your Pinnacle unit has been shipped with arc handling enabled. You should disable arc handling only if your system includes special post-process equipment that provides arc interruption.

> ⚠️ **CAUTION:**
> **Disabling the Pinnacle unit's arc handling ability without providing external arc interruption could cause severe target damage.**

In addition to shipping with arc handling enabled, the Pinnacle unit ships with these arc handling defaults: metal target, 50 V trip level. These settings provide the highest through-put with minimal arc damage to metal targets.

You can change these and other arc handling settings through the Pinnacle Remote Active Panel or the serial (Host) port. But before changing any arc handling settings, first take some time to understand them:

- Voltage arc trip level
- TCC algorithm enable
- Target type
  - ‣ Metal
  - ‣ Non-metal
  - ‣ Custom
- Arc detect delay time
- Arc shutdown time

The following paragraphs describe what the arc handling settings are and how they might interact with each other, with your system, and with your process.

Voltage Arc Trip Level

By setting the voltage arc (V-arc) trip level you are indicating the voltage threshold at which the Pinnacle recognizes an arc. The best value for a voltage arc trip level is somewhere between your process's normal operating voltage and the typical low voltage that occurs when your system experiences a hard arc. The latter depends on your target type, but typical low voltages for hard arcs are between 10 and 25 V. Thus a reasonable voltage arc trip level might be 50 V. Note, however, that some target types experience hard arcs at 100 V, so do not assume that 50 V is right for all processes. To set the V-arc trip level, use the ARC menu on the Pinnacle Remote Panel or AE Bus/PROFIBUS Command **10** (see Chapter 4).

TCC Algorithm Enable

When the Target Condition Cycle (TCC) algorithm is enabled and the unit receives an on command, the Pinnacle microprocessor sets the arc detect time to 20 µs and initiates a series of trials (or "steps") to reach your desired setpoint ("the final setpoint"). To begin, the microprocessor sets an initial setpoint equal to 50% of the final setpoint. After 10 ms, the microprocessor checks the output level and sets a new interim setpoint equal to 125% of the output level. The microprocessor continues to check the output level and to set a new interim setpoint (always 125% of the averaged output level) every 10 ms until the output level is equal to 80% of the final setpoint. When 80% of the final setpoint is reached, the interim setpoint is set equal to the final setpoint, and the TCC algorithm ends. You can enable TCC mode through the ARC menu on the Pinnacle Remote Panel or through AE Bus/PROFIBUS Command **79** (see Chapter 4 for more information).

Note: You cannot enable the TCC algorithm if you have already set up ramping recipes.

Target Type: Metal

Use the metal setting only for metal targets. Indicating a metal target pre-selects an arc detect delay time of 0 µs during a normal process cycle and 20 µs during the TCC. It sets an arc shutdown time of 30 µsduring both a normal cycle and the TCC. You can select target type through the ARC menu on the Pinnacle Remote Active Panel or through AE Bus/PROFIBUS Command **30** (see Chapter 4 for more information).

Note: Units with a 10 kW inverter and a 208 V input configuration have a minimum arc shutdown time of 50 µs.

Target Type: Non-Metal

Use the non-metal setting if your target is, for example, silicon or carbon. Indicating a

Arc Detect Delay Time

Arc detect delay time is the length of time from when the supply senses an arc to when it interrupts output power. Selecting a target type of "metal" or "non-metal" will pre-select arc detect delay times for you. However, if you want a custom arc detect delay time, select one based on target conditions.

- For target conditions that require a power interruption at every arc event, select a detect delay time of 0.

- For target conditions that experience self-extinguishing arcs ("micro arcs"), select a detect time of 2 to 5μ.

- For times when you want to deliver more energy to the arc nucleation site, select one of the longer detect times (10 to 500 μs).

You can set a custom arc detect delay time through the ARC menu on the Pinnacle Remote Panel or through AE Bus/PROFIBUS Command **8** (see Chapter 4 for more information).

Note: The Pinnacle power supply design greatly reduces the power supply's stored energy. But we recognize that there are occasions when your Pinnacle power supply can enhance your process by delivering more energy during arc events. You can achieve this effect by selecting a long arc detect delay time. Avoid long arc detect delay times, except when you want this effect.

Arc Shutdown Time

Arc shutdown time is the length of time that the Pinnacle supply interrupts power flow in response to an arc. Selecting a target type of "metal" or "non-metal" will pre-select arc shutdown times for you. However, if you want a custom arc shutdown time, select one based on system conditions. To extinguish an arc properly, the power supply must interrupt power until the output (arc) current decays to a value near 0. The decay of output current largely depends on system cable inductance and the impedance of the arc. If you select an arc shutdown time that is shorter than the actual decay time of the arc current, then the Pinnacle automatically extends its arc control circuitry. You can set a custom arc shutdown time through the ARC menu on the Pinnacle Active Remote Panel or through AE Bus/PROFIBUS Command **8** (see Chapter 4).

Note: Units with a 10 kW inverter and a 208 V input configuration have a minimum arc shutdown time of 50 μs.

Arc Recovery Test

After the arc shutdown time has expired, the Pinnacle supply reapplies output power to the load and examines the output voltage level. The output voltage must rise above your selected V-arc trip level within an internally fixed time of 20 μs. If the output voltage rises above the V-arc trip level before the 20 μs period has ended, the Pinnacle power supply will resume normal output. If the output voltage does not rise above the

V-arc trip level by the end of the 20 μs time limit, then the Pinnacle unit initiates another arc shutdown. Metal flakes and unusually dirty target conditions may be responsible for multiple arc shutdowns. Connecting large capacitors (>.047uF) on the Pinnacle output can hinder the Pinnacle from achieving proper output voltage within 20 μs.

Arc Recovery Time

Recovery to the pre-arc output level usually occurs in less than 25 μs from the end of your selected arc shutdown time. This recovery time is typical when you have selected a metal target or an arc shutdown time between 10 μs and 2500 μs. However, it may be too rapid for some processes. Some target materials respond better to a slow (or "soft") recovery period. A "soft" recovery allows for greater plasma stability at the time of recovery or prevents any possibility of overshooting the operating point. If you select an arc shutdown time of 500 μs or greater, the unit automatically selects a 1 ms "soft" recovery time period.

Troubleshooting and Customer Support

BEFORE CALLING AE GLOBAL SUPPORT

> ⚠ **DANGER:**
>
> **RISK OF DEATH OR BODILY INJURY. Disconnect all sources of input power before working on this unit or anything connected to it.**

> ⚠ **WARNING:**
>
> **Operating and maintenance personnel must have the correct training before setting up, maintaining, or troubleshooting high-energy electrical equipment. Potentially lethal voltages may cause serious personal injury or damage to equipment. Ensure that proper safety precautions are taken.**

This chapter contains a general checklist of potential problem areas as well as lists of error codes and suggested responses. Please consult the appropriate section(s) if you believe you are experiencing trouble with your Pinnacle power supply. If the problem continues or if you cannot find an adequate solution in these pages, please call AE and ask to speak with a Global Support representative

First Check

If you believe you are experiencing problems with a Pinnacle supply, check for obvious signs of damage to the unit itself, cables, and connectors. If damage has occurred, turn off the unit and call AE Global Support. If there are no obvious signs of damage, proceed with the checks on the following lists.

Checks with the Power Off

1. Ensure the power to the unit is off.

2. Check for visible damage to the unit, cables, and connectors.

3. Ensure all unit connectors are installed correctly and are fastened tightly.

4. Check to determine whether any system-related circuit breakers have been tripped.

5. Ensure there is input power to both the unit and the remote.

6. Ensure that input power meets specifications. (See the "Specifications" chapter for specifics.)

7. Ensure ground connections are adequate and secure.

8. Check the position of the switches on the DIP for the serial (Host) port (if your unit has a Host port) against the addressing information in the "I/O Communication and Control" chapter.

9. Ensure that the interlock loop is closed both at the contactor interlock and at the User port. (See the description of the contactor interlock in the "Installation" chapter for m-6iuurur7-0(r) SB0(e)-1lNu 8R034 1 Tf0(5r)9. has95 0msdi1C-2.1(c.'50(5r)9.b(r)a)9(mee(

9. Determine whether the cooling fans are functioning, and ensure your cabinet allows for adequate ventilation for all the units in the cabinet. (To determine the correct volumes, see the "Installation" chapter.) If the fans are not functioning properly, call AE Global Support.

Checks if the Output Does Not Turn On

1. Verify that the joules mode is disabled or has a valid setpoint value. (For more information, read about the "Energy" function in the "I/O Communication and Control" chapter.)

2. Verify that the target life counter is disabled or has a valid value. (For more information, read about the "Target" function in the "I/O Communication and Control" chapter.)

3. Verify that the user-definable power, voltage, and current limits are set to values reasonable for the process application.

4. Check for interlock, bus fault, or over-temperature faults.

5. Verify that you have established a valid setpoint.

6. For dual Pinnacle supplies, verify that both inverters are enabled. For more information, consult the descriptions of error codes E040, E041, and E042 in the Error Code table in this chapter.

Help Code Troubleshooting Table

In certain cases, your unit may display one of the following help codes.

Table 7-1. Active Display Panel Help Codes

Help Code Number and Message	Problem Indicated	Suggested Action
H000 Faults are Active	You requested output On while fault was active.	Clear fault and try again.
H001 Invalid Control Mode	You have selected a control mode not supported by your Pinnacle unit's configuration. Or you have tried to turn on output from an interface not currently selected for control mode.	Set the control mode to a valid value. See the "I/O Communication and Control" chapter for more information.

Table 7-1. Active Display Panel Help Codes *(Continued)*

Help Code Number and Message	Problem Indicated	Suggested Action
H002 Contactor is Open	The main contactor has not closed.	A fault may exist in your system. Power off the Pinnacle unit. Ensure that the interlock pin on the User port connector has been properly connected (see the "I/O Communication and Control" chapter). Ensure that all system interlocks have been satisfied. Power the unit back on. If the unit features PROFIBUS, clear the faults by sending Command **119**.
H003 Parameter Limit Exceeded	You have attempted to set an operating parameter to a value outside its allowable range.	Set a valid value for the parameter. See the "I/O Communication and Control" chapter for more information.
H004 Invalid Setpoint Source	You have attempted to send a setpoint value from an interface that has not been identified as the program source for setpoint.	Use the proper interface to set the Pinnacle unit's setpoint. Or reset the unit's program source parameters. For more information, see the "I/O Communication and Control" chapter.
H005 Ramping is Active	You have attempted to initiate a unit function that is not allowed during ramping.	Delay initiating the desired function until ramping is complete. Or turn off output and disable ramping before attempting to initiate the desired function again. For more information, see the "I/O Communication and Control" chapter.

Table 7-1. Active Display Panel Help Codes *(Continued)*

Help Code Number and Message	Problem Indicated	Suggested Action
H006 AE Bus: Data Byte Count Incorrect	The number of data bytes sent does not match the number of data bytes required by the AE Bus command.	Check the command's requirements and resend the command. See the For more information, see the "I/O Communication and Control" chapter for more information.
H007 User Port has Priority	After selecting a target other than 1 from the User port, you have attempted to select another target through another interface (that is, through either a serial (Host) port or a panel).	Use the User port to select the target. Or, to select the target through another interface, select target 1 from the User port. *Note:* When you have selected a target greater than 1 through the User port, the User port's target setting has priority.
H008 Target Conditioning is Active	The Target Condition Cycle (TCC) mode is active, and the requested command cannot execute during the TCC.	Disable the TCC mode before attempting to initiate this function again. For more information, see the "I/O Communication and Control" chapter.
H009 User Port Reset is Active	The User port reset is asserted.	De-assert the User port reset function. See the "I/O Communication and Control" chapter for more information.
H010 Host Port: Reset Asserted	Host port command reset asserted.	This is not a fault, only an indication.
H011 A: Arc Handling Disabled	You attempted to change arc handling parameters when the arc handling feature was disabled on Side A.	Enable arc handling in Side A.

Table 7-1. Active Display Panel Help Codes *(Continued)*

Help Code Number and Message	Problem Indicated	Suggested Action
H012 B: Arc Handling Disabled	You attempted to change arc handling parameters when the arc handling feature was disabled on Side B.	Enable arc handling in Side B.
H013 A: Ramp Feature Disabled	The requested action could not be performed, because the ramp feature is disabled on Side A.	Enable the ramp feature on Side A.
H014 B: Ramp Feature Disabled	The requested action could not be performed, because the ramp feature is disabled on Side B.	Enable the ramp feature on Side B.
H015 A: TCC Mode Enabled	The requested action could not be performed, because the TCC feature is enabled on Side A.	TCC, Ramp, and Recipe features are mutually exclusive. Disable the TCC feature on Side A and repeat the action.
H016 B: TCC Mode Enabled	The requested action could not be performed, because the TCC feature is enabled on Side B.	TCC, Ramp, and Recipe features are mutually exclusive. Disable the TCC feature on Side B and repeat the action.
H017 A: Ramp Mode Enabled	The requested action could not be performed because the ramp feature is enabled on Side A.	TCC, Ramp, and Recipe features are mutually exclusive. Disable the Ramp feature on Side A and repeat the action.
H018 B: Ramp Mode Enabled	The requested action could not be performed because the ramp feature is enabled on Side B.	TCC, Ramp, and Recipe features are mutually exclusive. Disable the Ramp feature on Side B and repeat the action.
H019 User port **idle.d** is active	The *idle.d* line on the User port has been asserted.	Review User port functionality and assert/de-assert *idle.d* as needed.
H020 User port **standby.d** is active	The *standby.d* line on the User port has been asserted.	Review User port functionality and assert/de-assert *standby.d* as needed.

Table 7-1. Active Display Panel Help Codes *(Continued)*

Help Code Number and Message	Problem Indicated	Suggested Action
H021 Side A: Ramp Parameters Out of Range	The start and endpoints are the same or so close together that the accuracy of the ramp increment is exceeded.	Re-adjust the ramp start point by setting a smaller percentage. Ramp must be at least 100 units in length. See the "Setting the Ramp" section in Chapter 4 for a description of the ramp option.
H022 Side B: Ramp Parameter Out of Range	The start and endpoints are the same or so close together that the accuracy of the ramp increment is exceeded.	Re-adjust the ramp start point by setting a smaller percentage. Ramp must be at least 100 units in length. See the "Setting the Ramp" section in Chapter 4 for a description of the ramp option.
H099 AEBus: Command Not Implemented	The Pinnacle unit does not support the command most recently sent by the computer host.	Review the list of commands, see Chapter 4 for a complete list of commands.

Passive Display Panel Codes

When only a Passive Front Panel (PFP) is available, the Pinnacle unit will display 4 character strings on start up to identify personality cards installed in the unit. A code will flash once for each card installed. The following table describes the strings:

Table 7-2. Passive Display Panel Help Codes

PFP Display String	Personality Card
H----	No cards
H-01	Dual User card
H-03	PROFIBUS card
H-04	Host Protocol Translator card
H-05	Single User card
H-18	AE Bus card
H-22	Master/Slave card
H-30	DeviceNet

LED Troubleshooting Table

Refer to this table before you call AE Global Support .

Table 7-3. Troubleshooting LEDs

LED	On	Off	Status
POWER	X		Normal
POWER		X	The Pinnacle unit is not receiving AC input power. Power the unit off. Using all applicable safety precautions, inspect your AC input power source to ensure that it is properly connected and that the specified voltage is being applied to the Pinnacle unit. (See the "Specifications" chapter for AC input power specifications.)
OUTPUT	X		Normal
OUTPUT		X	The Pinnacle unit is not producing output. See "Checks if the Output Does Not Turn On" on page 7-3.
SETPOINT	X		Normal
SETPOINT		X	The Pinnacle unit is not operating within setpoint. Note the error code on the display and see "Error Code Troubleshooting Table" on page 7-10.
INTERLOCK	X		Normal
INTERLOCK		X	An interlock fault condition exists. Note the error code on the display and see "Error Code Troubleshooting Table" on page 7-10.
BUS FAULT	X		A bus fault condition exists. Note the error code on the display and see "Error Code Troubleshooting Table" on page 7-10.
BUS FAULT		X	Normal
OVERTEMP	X		An over-temperature fault condition exists. Note the error code on the display and see "Error Code Troubleshooting Table" on page 7-10.
OVERTEMP		X	Normal
ARC	X		After the output shuts off, this LED lights momentarily to indicate that the hard arc count limit was reached during the previous run.
ARC		X	During an on cycle, this LED normally remains unlit. After the output shuts off, if this LED remains unlit, the hard arc limit was not reached during the previous run.

If you cannot identify the problem by following this checklist, please call AE Global Support. If the unit's front panel or Pinnacle Remote Active Panel displays an error code, see "Error Code Troubleshooting Table" on page 7-10. To reset the unit's user-selectable parameters to the factory defaults, read about the default function in Chapter 4.

Clearing the Error Code

Error codes are typically generated by two types of faults: self-clearing or explicit clear. When the unit experiences a self-clearing fault condition, the unit turns off output and displays an error code on the panel. When the fault condition is no longer present in the system, the panel ceases to display the error code. (You then can turn on the output.)

When the unit experiences an explicit-clear fault condition, the unit turns off output and displays an error code. Once the fault condition is no longer in the system, you must acknowledge the condition from your controlling interface before turning on output.

To reset the Pinnacle unit, do *one* of the following:

- From the front panel, press the OFF button to acknowledge the condition. Then press the ON button to turn on output.

- Through the DeviceNet interface, send the Poll Command message twice: once to turn off output and once to turn on output (see the description of Byte 4).

- Through the AE Bus interface, serial port or PROFIBUS interface send the OFF command, then send the ON command to turn on output.

- Through the User port interface, release and reestablish closure between pins 4 and 9 to turn off and on the output.

Error Code Troubleshooting Table

Use the following table to trouble shoot error codes.

Table 7-4. *Active Panel Display Error Codes*

Error Code Number and Message	Problem Indicated	Suggested Action
E000 DSP INIT Control Fault	The DSP failed to respond to the processor.	Power the unit off and then back on. If the error code reappears, contact AE Global Support.
E001 A: Out-of-Setpoint timer expired	The out-of-setpoint timer has expired on Side A.	Increase the setpoint timer value or disable the timer by setting it equal to 0. If the problem persists, check your process parameters for limiting factors. That is, ensure that your load impedance matches the impedance of the Pinnacle unit.
E002 Bus Fault	The buses have failed, probably due to an AC input power problem.	Using all applicable safety precautions, inspect your AC input power source to ensure that it is properly connected and that the specified voltage is being applied to the Pinnacle unit. (See the "Specifications" chapter for AC input power specifications.)
E003 Bus Not Ready	The bus failed to power up when the contactor closed, probably due to an AC input power problem.	Using all applicable safety precautions, inspect your AC input power source to ensure that it is properly connected and that specified voltage is being applied to the Pinnacle unit. (See the "Specifications" chapter for AC input power specifications.)

Table 7-4. *Active Panel Display Error Codes   (Continued)*

Error Code Number and Message	Problem Indicated	Suggested Action
E004 Heat Sink Over-Temperature	The unit is overheating.	Inspect the unit's cooling system and review cooling specifications: ensure that the input air temperature is correct, that the Pinnacle unit's fans are functioning properly, and that your cabinet allows for adequate ventilation for all the units in the cabinet. For more information, see the "Installation" chapter.
E005 Momentary Power Fluctuation	The AC input power line dipped below required operating conditions. This condition may be due to an AC power black-out or brown-out.	Using all applicable safety precautions, inspect your AC input power source to ensure that it is properly connected and that the specified voltage is being applied to the Pinnacle unit. (See the "Specifications" chapter for AC input power specifications.)
E006 DSP Watchdog Failure	The DSP has failed.	Call AE Global Support.
E007 NOVRAM is not Initialized	The NVRAM is not initialized. Occurring rarely, this error code indicates a problem with the unit's NVRAM, which is typically initialized during unit manufacturing at an AE facility.	Call AE Global Support.

Table 7-4. *Active Panel Display Error Codes* *(Continued)*

Error Code Number and Message	Problem Indicated	Suggested Action
E008 B: Out-of-Setpoint Timer Expired	The out-of-setpoint timer has expired on Side B.	Increase the setpoint timer value or disable the timer by setting it equal to 0. If the problem persists, check your process parameters for limiting factors. That is, ensure that your load impedance matches the impedance of the Pinnacle unit.
E009 Ground Fault Detected	Output positive terminal is not Protective Earth (PE) grounded.	Connect output positive terminal to PE ground.
E010 Side A: Process Voltage Low	The voltage at output on Side A has dropped below the "process voltage" value you have set.	Re-program or disengage the Pinnacle unit's process voltage check feature. For more information, see Chapter 4.
E011 Side A: Inverter Fault Occurred	Side A's power inverter cannot produce power.	Using all applicable safety precautions, inspect your AC input power source to ensure that it is properly connected and that the specified voltage is being applied to the Pinnacle unit. Check the input power line voltage on all phases to ensure that it meets specifications (see the "Specifications" chapter). Run the power supply to a dummy load to determine if it will indeed produce voltage or current.

Table 7-4. *Active Panel Display Error Codes   (Continued)*

Error Code Number and Message	Problem Indicated	Suggested Action
E012 Side B: Inverter Fault Occurred	Side B's power inverter cannot produce power.	Using all applicable safety precautions, inspect your AC input power source to ensure that it is properly connected and that the specified voltage is being applied to the Pinnacle unit. Check the input power line voltage on all phases to ensure that it meets specifications (see the "Specifications" chapter). Run the power supply to a dummy load to determine if it will indeed produce voltage or current.
E013 Side B: Process Voltage Low	The voltage at output on Side B has dropped below the "process voltage" value you have set.	Re-program or disengage the Pinnacle unit's process voltage limit check feature. For more information, see Chapter 4.
E014 Side A: Ramp Parameters Out of Range	You have attempted to set a ramp parameter to a value outside its allowable range.	Set a valid value for the parameter. (See Chapter 4 for more information).
E015 Side B: Ramp Parameters Out of Range	You have attempted to set a ramp parameter to a value outside its allowable range.	Set a valid value for the parameter. (See Chapter 4 for more information).
E016 Invalid Request While Output is On	You have attempted to change Joule Mode Enable while output is on.	See Chapter 4 for more information about setting the Joule Mode.
E20 Interlock Open: User	The system interlock on the unit's analog User port has not been satisfied.	Power off the Pinnacle unit. Ensure that the interlock pin on the User port connector has been properly connected (see Chapter 4). Ensure that all system interlocks have been satisfied. Power the unit back on.

Table 7-4. Active Panel Display Error Codes   (Continued)

Error Code Number and Message	Problem Indicated	Suggested Action
E021 Interlock Open: Cable	The cable between the logic card and the inverter output board has come loose.	Call AE Global Support.
E022 Interlock Open: Contactor	The unit's Contactor Interlock has not been satisfied.	Power off the Pinnacle unit. Ensure that the Contactor Interlock is properly connected. Ensure that all system interlocks have been satisfied. Power the unit back on. For more information about Contactor Interlock connector, see the "Installation" chapter.
E023 User Port Interlock Open	The system interlock on the unit's analog User port has not been satisfied. This condition may be to due to improper seating of the User port personality card.	Power off the Pinnacle unit. Ensure that the interlock pin on the User port connector has been properly connected (see Chapter 4). Ensure that all system interlocks have been satisfied. Power the unit back on. If the error reappears, call AE Global Support.
E024 Side A: Invalid Regulation Mode	The User port regulations mode for Side A has been set to an invalid request.	Set the User port regulation mode to a valid value. (See Chapter 4 for additional information.).
E025 Side A: Reset Target Life	The end of target life timer has expired or was never set for the active target. This error occurs only if the target life timer for Side A has been enabled.	Select the active target and set a new target life value. Or disable the target feature. For more information about these features, see Chapter 4.
E026 Side A: Incorrect Target Selected	This error code is not currently supported	Call AE Global Support.
E027 Side B: Invalid Regulation Mode	The User port regulations mode for Side B has been set to an invalid request.	Set the User port regulation mode to a valid value. (See the Chapter 4 for additional information).

Table 7-4. *Active Panel Display Error Codes   (Continued)*

Error Code Number and Message	Problem Indicated	Suggested Action
E028 Side B: Reset Target Life	The end of target life timer has expired or was never set for the active target. This error occurs only if the target life timer for Side B has been enabled.	Select the active target and set a new target life value. Or disengage the target feature. For more information about these features, see Chapter 4.
E030 Processor Flash Not Initialized	Flash memory was not initialized properly.	Call AE Global Support.
E031 Extended Flash Not Initialized	Flash memory not initialized properly.	Call AE Global Support.
E032 AFP Encoder Knob is Stuck	The MODIFY knob on the Pinnacle Remote Panel is stuck.	Push the MODIFY knob to clear the error. Power the unit off and on.
E040 Side A: Unit Not Enabled	The supply on Side A is not enabled.	On dual units, outputs from either A or B can be programmed not to turn on (that is, can temporarily be disabled). See Chapter 4 for more information.
E041 Side B: Unit Not Enabled	The supply on Side B is not enabled.	On dual units, outputs from either A or B can be programmed note to turn on (that is, can temporarily disabled). See Chapter 4 for more information.
E042 Neither Unit Enabled	The output is not enabled from either side of a dual unit.	See **E040** and **E041**.
E050 PROFIBUS RX Queue Overrun	PROFIBUS commands are being sent faster than they can be processed.	Slow down the PROFIBUS communication rate or the rate at which commands are sent. Make sure data consistency (module consistency) is enabled in the PROFIBUS master.

Table 7-4. Active Panel Display Error Codes   (Continued)

Error Code Number and Message	Problem Indicated	Suggested Action
E051 PROFIBUS A: Watch Dog Timer Expired	The PROFIBUS master stopped talking to the Side A Pinnacle supply after establishing communications.	Have the master re-establish communications and send a "master reset" to clear the Pinnacle unit's display.
E054 PROFIBUS A: MAC Reset/Offline	Side A's SPC has taken itself "off-line," probably in response to another error.	Cycle the Pinnacle unit's power off and on and re-establish communications between the master and slave. If the error code reappears, call AE Global Support.
E055 PROFIBUS A: Mem Buffer Overflow	A PROFIBUS command for Side A arrived before the last sent command was executed and cleared from memory.	Slow down the PROFIBUS communication rate or the rate at which commands are sent. Make sure data consistency (module consistency) is enabled in the PROFIBUS master.
E059 PROFIBUS A: Master Released Unit	The PROFIBUS master has stopped communicating with the Unit A Pinnacle unit using the proper protocol. This "slave" is now available to be "owned" by another master. If output is on, the Pinnacle unit turns off and fails safe.	To recover from the "off state," have a PROFIBUS master establish communication with the Pinnacle unit and send a "master reset" to clear the Pinnacle unit's display.
E061 PROFIBUS B: Watch Dog Expired	The PROFIBUS master stopped talking to the Pinnacle supply Side B after establishing communications.	Have the master re-establish communications and send a "master reset" to clear the Pinnacle unit's display.
E064 PROFIBUS B: MAC Resent/ Offline	Side B's SPC has taken itself "off-line," probably in response to another error.	Cycle the Pinnacle unit's power off and on and re-establish communications between the master and slave. If the error code reappears, call AE Global Support.

Table 7-4. Active Panel Display Error Codes   (Continued)

Error Code Number and Message	Problem Indicated	Suggested Action
E065 PROFIBUS B: Mem Buffer Overflow	A PROFIBUS command for Side B arrived before the last sent command was executed and cleared from memory.	Slow down the PROFIBUS communication rate or the rate at which commands are sent. Make sure data consistency (module consistency) is enabled in the PROFIBUS master.
E069 PROFIBUS B: Master Released Unit	The PROFIBUS master has stopped communicating with the Side B Pinnacle unit using the proper protocol. This "slave" is now available to be "owned" by another master. If output is on, the Pinnacle unit turns off and fails safe.	To recover from the "off state," have a PROFIBUS master establish communication with the Pinnacle unit and send a "master reset" to clear the Pinnacle unit's display.
Error Codes **E070** through **E079** are internal errors in the unit's logic card microprocessor.		
E070 Processor: Divide by zero	Internal software error.	Call AE Global Support.
E071 Processor: Single Step	Internal software error.	Call AE Global Support.
E072 Processor: Breakpoint	Internal software error.	Call AE Global Support.
E073 Processor: Overflow	Internal software error.	Call AE Global Support.
E074 Processor: Array Bound	Internal software error.	Call AE Global Support.
E075 Processor: Unknown op code	Internal software error.	Call AE Global Support.

Table 7-4. *Active Panel Display Error Codes   (Continued)*

Error Code Number and Message	Problem Indicated	Suggested Action
E076 Processor: Escape op code	Internal software error.	Call AE Global Support.
E077 Processor: Co-processor	Internal software error.	Call AE Global Support.
E078 Processor: Pre-defined Interrupt	Internal software error. On older Pinnacle units, this error code displays instead of error codes **E070** through **E077** as described above.	Call AE Global Support.
E079 Processor: Unassigned Interrupt	The Pinnacle unit's software has experienced an interruption and vectored to an unknown interrupt service routine.	Call AE Global Support.
E085 Side A: Setpoint Exceeds User Limit	The setpoint you have requested exceeds an output limit that you previously programmed.	Re-set the setpoint to a value lower than the existing output limit. Or re-program the relevant output limit (power, current, or voltage) to accommodate the setpoint. For more information, see Chapter 4.
E086 Side B: Setpoint Exceeds User Limit	The setpoint you have requested exceeds an output limit that you previously programmed.	Reset the setpoint to a value lower than the existing output limit. Or re-program the relevant output limit (power, current, or voltage) to accommodate the setpoint. For more information, see Chapter 4.
E117 User card A: Protect 1 Asserted	System interlock string is not satisfied.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *VAC* is satisfied. Power the unit back on.

Table 7-4. *Active Panel Display Error Codes   (Continued)*

Error Code Number and Message	Problem Indicated	Suggested Action
E118 User card A: Protect 2 Asserted	System interlock string is not satisfied.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *VAC* is satisfied. Power the unit back on.
E120 User Interlock Open: Aux	Single user card on Side A has an open interlock on the *AUX* pin.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *AUX* is satisfied. Power the unit back on.
E217 User card B: Protect 1 Asserted	System interlock string is not satisfied.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *VAC* is satisfied. Power the unit back on.
E218 User card B: Protect 2 Asserted	System interlock string is not satisfied.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *VAC* is satisfied. Power the unit back on.
E220 User Interlock Open: VAC	Single user card on Side A has an open interlock on the *VAC* pin.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *VAC* is satisfied. Power the unit back on.

Table 7-4. *Active Panel Display Error Codes   (Continued)*

Error Code Number and Message	Problem Indicated	Suggested Action
E320 User Interlock Open: Water	Single user card on Side A has an open interlock on the *WATER* pin.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *WATER* is satisfied. Power the unit back on.
E **420** User Interlock Open: Aux	Single user card on Side B has an open interlock on the *AUX* pin.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the User card pin *AUX* is satisfied. Power the unit back on.
E520 User Interlock Open: VAC	Single user card on Side B has an open interlock on the *VAC* pin.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the user card pin *VAC* is satisfied. Power the unit back on.
E620 User Interlock Open: Water	Single user card on Side B has an open interlock on the *WATER* pin.	Power off the Pinnacle unit. Ensure that the User interlock is properly connected. Ensure the interlock at the user card pin *WATER* is satisfied. Power the unit back on.

AE GLOBAL SUPPORT

Please contact one of the following offices if you have questions:

Table 7-5. *AE Global Support Locations*

Office	Contact

AE, World Headquarters
 	
1625 Sharp Point Drive
Fort Collins, CO 80525 USA
 	
Note: For returns and repairs, please call Global Support to get the correct shipping address.
	Phone (24 hrs/day, 7 days/week):
	    800.446.9167 or
	    970.221.0108
	Fax (M–F, 7:00 am – 5:30 pm MST):
	    970.407.5981
	
	Email: technical.support@aei.com
	  (We will respond to email by the next business day.)
	
	Note: For customers outside the US, please contact your local AE office.

AE, Voorhees, NJ 1007 Laurel Oak Road Voorhees, NJ 08043 USA	Phone: 800.275.6971 or 856.627.6100 Fax: 856.627.6159
AE, GmbH Raiffeisenstrasse 32 70794 Filderstadt (Bonlanden) Germany	Phone: 49.711.77927.0 Fax: 49.711.7778700
AE, Japan KK TOWA Edogawabashi Bldg. 347 Yamabuki-cho Shinjuku-ku, Tokyo Japan	Phone: 81.3.32351511 Fax: 81.3.32353580
AE, Korea Ltd. Gongduk Building, 4th floor 272-6 Seohyun-Dong, Bundang-Gu, Sungam Si Kyunggi, 463-050 Korea	Phone: 82.342.705.2100 Fax: 82.342.705.2766
AE, United Kingdom Unit 5, Minton Place, Market Court, Victoria Road Bicester, Oxon OX26 6QB UK	Phone: 44.1869.320022 Fax: 44.1869.325004

Table 7-5. AE Global Support Locations (Continued)

Office	Contact
AE, Taiwan, Ltd. 10F-6, No. 110, Chung Shan Rd. Sec. 3, Chungho City, Taipei Hsien Taiwan 235	Phone: 886-2-82215599 Fax: 886-2-82215050
AE, China Rm. 910 Anhui Building, No. 6007 Shennan Road, Shenzhen, China 518040	Phone: 86-755-3867986 Fax: 86-755-3867984

RETURNING UNITS FOR REPAIR

Before returning any product for repair and/or adjustment, *first follow all troubleshooting procedures*. If, after following these procedures, you still have a problem or if the procedure instructs you to, call AE Global Support and discuss the problem with a representative. Be prepared to give the model number and serial number of the unit as well as the reason for the proposed return. This consultation call allows AE Global Support to determine whether the problem can be corrected in the field or if the unit needs to be returned. Such technical consultation is always available at no charge.

If you return a unit without first getting authorization from AE Global Support and that unit is found to be functional, you will be charged a retest and calibration fee plus shipping charges.

To ensure years of dependable service, Advanced Energy® products are thoroughly tested and designed to be among the most reliable and highest quality systems available worldwide.

WARRANTY

Advanced Energy® (AE) products are warranted to be free from failures due to defects in material and workmanship for 12 months after they are shipped from the factory (please see warranty statement below, for details).

In order to claim shipping or handling damage, you must inspect the delivered goods and report such damage to AE within 30 days of your receipt of the goods. Please note that failing to report any damage within this period is the same as acknowledging that the goods were received undamaged.

For a warranty claim to be valid, it must:

• Be made within the applicable warranty period

- Include the product serial number and a full description of the circumstances giving rise to the claim

- Have been assigned a return material authorization number (see below) by AE Global Support

All warranty work will be performed at an authorized AE service center (see list of contacts at the beginning of this chapter). You are responsible for obtaining authorization (see details below) to return any defective units, prepaying the freight costs, and ensuring that the units are returned to an authorized AE service center. AE will return the repaired unit (freight prepaid) to you by second-day air shipment (or ground carrier for local returns); repair parts and labor will be provided free of charge. Whoever ships the unit (either you or AE) is responsible for properly packaging and adequately insuring the unit.

Authorized Returns

Before returning any product for repair and/or adjustment, call AE Global Support and discuss the problem with them. Be prepared to give them the model number and serial number of the unit as well as the reason for the proposed return. This consultation call will allow Global Support to determine if the unit must actually be returned for the problem to be corrected. Such technical consultation is always available at no charge.

Units that are returned without authorization from AE Global Support and that are found to be functional will not be covered under the warranty (see warranty statement, below). That is, you will have to pay a retest and calibration fee, and all shipping charges.

Warranty Statement

The seller makes no express or implied warranty that the goods are merchantable or fit for any particular purpose except as specifically stated in printed AE specifications. The sole responsibility of the Seller shall be that it will manufacture the goods in accordance with its published specifications and that the goods will be free from defects in material and workmanship. The seller's liability for breach of an expressed warranty shall exist only if the goods are installed, started in operation, and tested in conformity with the seller's published instructions. The seller expressly excludes any warranty whatsoever concerning goods that have been subject to misuse, negligence, or accident, or that have been altered or repaired by anyone other than the seller or the seller's duly authorized agent. This warranty is expressly made in lieu of any and all other warranties, express or implied, unless otherwise agreed to in writing. The warranty period is 12 months after the date the goods are shipped from AE. In all cases, the seller has sole responsibility for determining the cause and nature of the failure, and the seller's determination with regard thereto shall be final.

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